

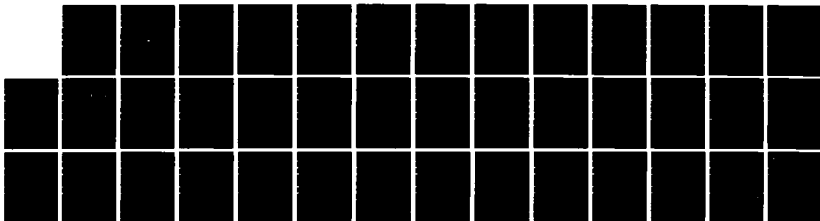
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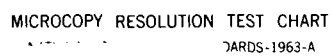
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EUROPEAN SCIENTIFIC NOTES

ESN 38-11

November 1984



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BEHAVIORAL SCIENCES

Dimensions of School Motivation Richard E. Snow 563

A collaboration between Scottish and Hungarian researchers is providing a new description of motivation related to school learning.

Intelligence, Information Processing, and the
Problem of Cognitive Styles: The Case of
Field-Dependence-Independence Richard E. Snow 564

New initiatives in European research are pushing the frontiers of the argument about field-independence-dependence versus intelligence.

BIOLOGICAL SCIENCES

Eliminating Radioisotopes in Immunoassays Thomas C. Rozzell 567

The Sixth International Colloquium of Radioimmunology, held in Lyon, France, featured discussions of alternatives to the use of radioisotopes for immunoassays.

German Groups Conduct Broad Range of Research
on Post-trauma Treatment Thomas C. Rozzell 569

The Institute for Experimental Surgery of the Technical University Munich and the Garmisch-Partenkirchen Hospital have research programs dealing with: (1) electrical stimulation of bone, (2) implantation of limbs and joints, (3) drug delivery and artificial skin, and (4) fibrin adhesion and skin grafts.

EARTH SCIENCE

European Geophysical Society Meets in Belgium Norman F. Ness 572

The Tenth Annual Meeting of the European Geophysical Society was held in Belgium from July 30 through August 3.

NERC Sponsors Remote Sensing Program Robert Dolan 573

The UK's Natural Environment Research Council funds a variety of remote sensing projects by its own labs and by scientists at universities.

- Symposium on Climate and Paleoclimate of Lakes,
Rivers, and Glaciers Robert Dolan 576

Glaciers were the topic of greatest interest at the symposium, held in Igles, Austria, from June 4 through 7. Most of the research was based on the analysis of ice cores, terminal moraines, or change mapping using aerial photography.

ELECTRONICS

- VLSI at the Autonomous University of Barcelona J.F. Blackburn 578

Research in very large scale integration at the Autonomous University of Barcelona, Spain, includes work on a logical circuit recognizer, an integrated-circuit rules checker, and a silicon compiler.

GENERAL

- MOD Changing UK's Defense Policy Chester McKinney 579

A recent UK Ministry of Defence White Paper spells out government plans for reorganization and the trends to be expected.

- UK Admiralty Reorganizes R&D Chester McKinney 581

Sweeping organizational changes have recently affected the UK Admiralty's R&D establishments.

MATERIAL SCIENCES

- Welding Research at British Steel Corporation Kenneth D. Challenger 583

The Welding Branch at British Steel's Sheffield Laboratory is doing research on: (1) new, weldable, high-strength, low-alloy steels; (2) the improvement of productivity using existing materials; and (3) the development of new submerged-arc-welding consumables.

OPERATIONS RESEARCH

- TIMS Meets in Copenhagen Robert Machol 585

The Institute of Management Sciences' biennial meeting dealt with topics such as the evolution of digital computers, applications of management science to education, legal problems, and military management science.

TECHNOLOGY

- UK's Institute of Acoustics is Healthy and Growing Chester McKinney 587

The UK's Institute of Acoustics is active, with programs that include conferences, publications, and professional awards.

NEWS & NOTES

Long-Distance Diagnostic System	Thomas C. Rozzell	589
Oxford Appoints New Head for Geography	Robert Dolan	589
ZWO Announces Award Winners	Larry E. Shaffer	589

Science Newsbriefs	591
Military Applications Summary Bulletins	592
ONRL Reports	592

ESN Invites Letters to the Editor

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BEHAVIORAL SCIENCES

DIMENSIONS OF SCHOOL MOTIVATION

by Richard E. Snow. Dr. Snow is the Liaison Scientist for Psychology in Europe and the Middle East for the Office of Naval Research's London Branch Office. He is on leave until September 1985 from Stanford University, where he is Professor of Education and Psychology.

US research on motivation related to school learning has used a wide variety of approaches, with many different theoretical bases, and has generated a large number of explanatory constructs. But it has been piecemeal work, by and large, without programmatic direction and certainly without general integration (Ball, 1977). There have been notable exceptions (e.g., Atkinson and Feather, 1966), but even these concentrate on relatively narrow-range constructs with special theoretical goals. And the constructs and goals have been almost exclusively cognitive, rather than affective or conative.

Now a collaboration between Scottish and Hungarian researchers seems to provide a new and more comprehensive description on which further, more integrated work can be based. It is hardly the last word. But because it is built directly out of an open view of classroom events and experiences, rather than from some imposed theoretical predisposition, it is less likely to leave important domains of school motivation out of consideration. It also seems to connect the different aspects of school motivation to the contrasting approaches students often take to school learning--an important connection between motivation and action.

The work originated with Kozeki's (1975) extensive interview studies of sources of motivated behavior among Hungarian students. There followed the development and revision of an inventory of questionnaire items to represent these dimensions, and extensive factor analytic studies in large samples of students aged 8 to 20 in Hungary, Czechoslovakia, Romania, East Germany, and now in Britain. The rationale and data analyses are described in detail by Kozeki and Entwistle (in press, no date; see also Kozeki, 1976 and 1981).

The original conception based on interviews identified the nine hypothesized dimensions shown in Table 1. As Kozeki and Entwistle (no date, p. 5)

describe personality development in the age range studied, the three main sources of reward and punishment as children grow older are parents, teachers, and peers. These cross with development in three domains--affective, cognitive, and moral:

"Over time these sources of primary reinforcement extend to areas of secondary reinforcement and become internalized. For example, out of warm relationships with parents, children are gradually encouraged to develop independence rooted in mutual trust. Similarly the early identification with teachers develops into an active search for competence, and compliance with the norms of behaviour required for effective classroom activities. Finally, sociability with peers leads, in the classroom, to shared interest in some aspects of schoolwork, and an acceptance of personal responsibility in balancing individual needs with those of others."

Also shown in Table 1 is a summary of the results of the several factor analyses based on both British and Eastern European samples. An eight-factor solution appeared best overall and corresponds with eight of the nine hypothesized dimensions. No separate factor appeared for "trust"; the items designed for this scale combined with those for "responsibility." The meaning of the eight factors remained quite similar across analyses in the British and Hungarian samples and also within and between gender groups in each sample. The factors were correlated, suggesting the second-order factor of "general school motivation," but were also sufficiently separable for use as distinct constructs.

Though mean comparisons between the groups can be only suggestive, given differences in sampling procedure in the two countries, there were indications that the Hungarian averages were consistently higher than the British. Female scores were also higher than male scores in both countries, particularly on warmth, sociability, and compliance. British students appeared more critical of teachers, but showed higher recognition of the value of school work than did Hungarian students. Hungarian students saw collaborative work as more important than competition and punishment in school as fair.

Kozeki and Entwistle also provided evidence for the internal consistency of the scales and their validity against teacher ratings of aspects of school motivation. They suggest that the emergent instrument and its theoretical rationale should be particularly useful

Table 1

Hypothesized Motivational Dimensions and Obtained Factors

<u>Domain</u>	<u>Source of Reinforcement</u>	<u>Hypothesized Dimensions</u>	<u>Description of Obtained Factors</u>
Affective	Relationships with parents	Warmth	Warm relationships with adults
	Teachers	Identification	Good relationships with teachers and acceptance of school
	Peers	Sociability	Cooperative relationships with peers
Cognitive	Relationships with parents	Independence	Self-confidence and independence
	Teachers	Competence	Intention to work hard and seek knowledge
	Peers	Interest	Satisfaction with school and interest in school work
Moral	Relationships with parents	Trust	--
	Teachers	Compliance	Compliance with authority
	Peers	Responsibility	Acceptance of responsibility

in further research, both on the individual student level and as a way of building motivational profiles at the class or school level to describe group ethos or "personality." Relationships among the dimensions, studied in longitudinal or path analytic perspective, should also be important foci for further research.

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8/20/84

INTELLIGENCE, INFORMATION PROCESSING, AND THE PROBLEM OF COGNITIVE STYLES: THE CASE OF FIELD-DEPENDENCE-INDEPENDENCE

by Richard E. Snow.

German researchers in the Gestalt tradition of the 1920s began to form distinctions among persons based on the characteristic ways they seemed to

process information, particularly perceptual information (see, e.g., Jaensch, 1929). The distinctions were typological--for example, there were objective versus subjective perceivers, analyzers versus synthesizers, and so on. German psychoanalytic psychology also developed the notion that differences in stylistic perception could indicate different pathologies; the famous Rorschach ink-blot test was one result (Rorschach, 1942). In US research following World War II, a tradition loosely connected to the old German work began as the "New Look" movement in the psychology of perception; it was designed to put the person back into theories of perceptual processing. The individual-differences wing of this movement then grew up under the general heading of "cognitive styles."

Cognitive styles are supposed to be individual differences among persons in their characteristic modes of perceiving and thinking. These modes have been variously described as information-processing strategies, perceptual preferences, cognitive control principles, and the like. Their importance stems from the implication that they reflect something more than, or different from, cognitive abilities such as intelligence or personality traits such as anxiety. They seem even to combine aspects of ability and personality and thus to provide new, more holistic, and more process-based constructs with which to study individual differences in complex learning, problem solving, and decision making.

There is great interest in the notion of cognitive style today. On the theoretical side, such constructs seem to connect directly with the new information-processing psychology of cognition, its new theories of human and artificial intelligence, and its growing interest in integrating cognition, conation, and affect. On the practical side, the measures representing such constructs may help improve the validity of selection and classification decisions and the diagnosis of various kinds of maladjustments. Critics of conventional mental testing, especially, see style constructs as replacing what they regard as the outmoded concepts and measures of intelligence; "style" implies qualitative differences without implying quantitative differences in amount or level of ability among persons.

Unfortunately, research on cognitive styles has been severely limited by its tendency to study each style construct in isolation, as it relates to various real-world performances or characteristics of interest, but without

any serious attempt to pursue its convergent and discriminant validity with respect to apparently related constructs. Thousands of narrow empirical studies have been published over recent decades without substantial advance in the theoretical understanding of cognitive styles.

By far the most popular and the most studied cognitive style construct has been field-dependence-independence (FDI). Developed over 30 years of research led by Witkin, this style represents a generalized tendency toward or away from psychological differentiation. The field-independent (FI) person analyzes complex stimulus fields, can decontextualize focal stimuli, and keep track of details and restructure them in solving problems. The field-dependent (FD) person uses more global percepts, is more sensitive to contextual cues and thus more influenced by the contextual field. The FI person will thus do better in the solving of problems typically found on field intelligence and spatial-ability tests, whereas the FD person will typically do better in situations involving reliance on external referents and sensitivity to relationships, particularly social relationships. There are many other connected hypotheses, including neurophysiological hypotheses relating to hemispheric differentiation and the relative separation of neural pathways of FI and FD persons. For an up-to-date review of the FDI theory and evidence, see Witkin and Goodenough (1981).

There have also long been criticisms of the FDI theory stemming from work on both sides of the Atlantic. For reviews of the argument, see Cronbach (1984) and Vernon (1972). For a critique of the extensive cross-cultural research on FDI, see Laboratory of Comparative Human Cognition (1982). The most basic criticism, most briefly put, is that FDI is not distinguishable from fluid intelligence.

Contemporary research in several European laboratories is focusing on this issue and elaborating our understanding of it in several ways. This article samples from three lines of this work. An article in a future ESN will review work on some other, related, cognitive style constructs.

McKenna's (in press) work at the Medical Research Council-Applied Psychology Unit, Cambridge, UK, is one example. Based on a review of older work and some new studies of his own, McKenna concludes that FDI does not meet the criteria for a cognitive style construct--as distinct from cognitive ability--at either conceptual or empirical

levels. Conceptually, it is argued that the measures of FDI reflect accuracy and response latency, and thus level of performance, not manner or style of performance. The measures are maximum performance not typical performance measures; persons cannot score better than they are able to--hence the score reflects ability, namely the ability to overcome stimulus embeddedness. McKenna then reviews the empirical work, bringing together the mass of correlations between Witkin's Embedded Figures tests and measures of general ability (such as the Wechsler or the Scholastic Aptitude Test), spatial ability (such as Paper Folding and Surface Development), and fluid ability (such as Raven Progressive Matrices or the Cattell Culture Fair Intelligence Test). The routine size of such correlations raises substantial doubt that FDI is distinct from ability or that much systematic variance remains in FDI when ability is partialled out.

It is still possible, however, that ability does not account for all the systematic variance in FDI. Groot (1981), at Tilburg University in The Netherlands, has been addressing this possibility. He hypothesizes that FDI performance reflects ability for relatively nonanxious persons, but anxiety in the test situation for others; a motivational state variable thus serves as a moderator to produce differential construct validity of the FDI scores for different persons. Using state anxiety measures, including heart rate in the test situation, his evidence suggests the familiar inverted U-shaped function of the Yerkes-Dodson Law. The poorest FDI performance (i.e., low field independence) is shown by the most anxious individuals, whereas moderately aroused individuals show the best FDI performance (i.e., high field independence) and do somewhat better than the most relaxed individuals. The curves differ somewhat for different FDI measures, however, and for males and females; only some differences were statistically significant. It is also shown that FDI measures correlate substantially with an index of academic intelligence among individuals classed in a moderate or modal state-motivation group, but do not correlate significantly with this index among individuals classed in an extreme (high or low) state-motivation group. Correlations between state and trait measures of motivation and anxiety, and some eye movement analyses suggestive of strategy differences among the groups, are also reported. The study is a small-scale exploration, but it is highly suggestive.

A third line of work comes from the Free University of Amsterdam in The Netherlands (Ippel and Bouma, 1981; Bouma and Ippel, 1983). The ability factors of closure flexibility and closure speed were used to represent analytic versus global or holistic processing, respectively, but the aim was to explore the hypothesized links between FDI and hemispheric specialization. Some of the closure measures are similar, but not identical, to the Witkin FDI measures. Persons were first classed as high or low on closure speed and also on closure flexibility. They then performed three tachistoscopic tasks, one requiring verbal recall and two binary classification tasks with visual-spatial stimuli, presented so that separate scores could be obtained for performance in the left and right hemifields.

The results of these first studies are difficult to interpret because of methodological problems resulting from nonorthogonality among the ability factors. There does seem to be support here for the hypothesis that these ability groups differ in their proficiency in analytic processing and that differences in holistic processing proficiency are related to closure-speed ability. The interaction between proficiency in analytic and holistic processing and several task characteristics may reflect differences in the way in which the left and right cerebral hemispheres are involved in visual processing and clearly deserve further study in this regard.

In short, some new initiatives in European research are pushing the frontiers of the FDI-versus-intelligence argument. They deserve to be watched closely.

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8/21/84

BIOLOGICAL SCIENCES

ELIMINATING RADIOISOTOPES IN IMMUNOASSAYS

by Thomas C. Rozzell. Dr. Rozzell is the Liaison Scientist for Biological Sciences in Europe and the Middle East for the Office of Naval Research's London Branch Office. He is on reassignment until August 1985 from the Office of Naval Research, Arlington, VA, where he is Program Manager for Cellular Biosystems.

For about 20 years the radioisotope ^{125}I has been used to label antibodies, antigens, hormones, and other proteins in order to obtain quantitative and qualitative assays. In fact, the use of such immunological methods rapidly became the standard way to determine the amounts of a number of compounds and body chemicals because these assays were far more sensitive and more specific than other methods. Immunological methods have been used especially for clinical investigation of compounds that are in very low concentrations and for which chemical methods of determination are not sufficiently specific--e.g., various proteins (antibodies and enzymes); hormones (thyroxine, steroids, and peptide hormones); and certain classes of drugs.

In the mid to late 1970s it was suggested that it might be possible to do away with the radioisotopes and use other compounds that were either fluo-

rescent or luminescent. The search for such compounds and the concomitant instrumentation development has accelerated in the past 4 or 5 years, especially in the US. However, the work has been slow getting off the ground in Europe. At the Sixth International Colloquium of Radioimmunology--held in Lyon, France, during April--there was evidence that alternative methods may finally be coming into their own in Europe. In this article I will attempt: (1) to explain briefly why it is important to find new assay techniques, (2) to give a short explanation of the two most promising new alternatives to radioimmunological assay, and (3) to show why it is important for the US Navy to consider these alternatives.

Even though radioimmunological methods are the most widely used and are extremely sensitive, they have certain disadvantages. Of primary importance is that the use of radioactive isotopes requires a special laboratory and special licensing. The requirement of special licensing carries with it the necessity of special record keeping. Using radioactive materials poses a potential health hazard to laboratory workers and presents a potential liability to the operating institution. The instrumentation used for counting the isotopes is expensive, as are the reagents themselves. Counting samples is time consuming, in spite of the fact that the counting is automated. Finally, the useful lifetime of the assay materials (reagents) is limited by the half-life of the radioactive isotope.

Fluorescent Methods

At the Lyon colloquium, Professor Roger Ekins (Middlesex Hospital Medical School, UK) lectured on the pulsed-light, time-resolved, fluoroimmunoassay technique, which he predicts is the "wave" of the future. Fluorescent and chemiluminescent methods are closely related to the radioisotopic measurement techniques in that each "labels" substances with a form of detectable radiation. In the case of fluorescent and chemiluminescent methods, the radiation arises as a consequence of an input of external energy in the form of light in the former case or chemicals in the latter.

In "conventional" fluorescence, photons of light are directed at the fluorescent marker, the photons are absorbed, and longer wavelength photons are given off by the marker.

Thus, while the energy released in the radioactive decay of an isotope like ^{125}I derives from the prior exposure of

the atoms to neutrons, and the energy of the photons emitted by a chemiluminescent label is released as a result of a chemical reaction, the energy for fluorescent photons comes from concurrent, *in-situ* exposure to a light source. Normally, the fluorophor returns to the ground state after it is excited and photon emission occurs. The typical excitation radiation is a pulse of monochromatic light on the order of a few nanoseconds. Following excitation, the emitted fluorescence decays exponentially with time in a characteristic manner. Generally, background fluorescence is of much shorter duration, and if one simply waits a short time before counting, the background is missed, and only the emission from the desired fluorophor is detected (Figure 1). Such a system may be used to detect the fluorescent signals from fluorophors characterized by different decay times in a manner somewhat analogous to the method of identifying radioisotopes on the basis of their differing half-lives (Soini and Hemmila, 1979).

The lifetime (i.e., the time required for the fluorescein emission to decay to 1/e of its initial intensity following excitation) of the emission of serum proteins and many other normal organic substances is on the order of 10 ns. Fortunately, a unique group of fluorophors has been found that have fluorescent decay times that are 3 to 4 orders of magnitude longer than this. They are chelates of the lanthanide elements, europium and terbium. The chelates of these rare earth elements exhibit fluorescent decay times from 1 μ s to 1 ms (Ekins, 1984). The prolonged decay times of these compounds are believed to be due to the fact that the light energy absorbed by the molecule is transferred internally to the chelated rare earth atoms, which then emit fluorescent photons. In addition, the lanthanide chelates exhibit large Stokes shifts (the difference in wavelength between the exciting and the emitted photons). For example, when the europium chelate is excited with light with a wavelength of 340 nm, it emits fluorescence in a narrow wavelength band around 613 nm. Thus there is a Stokes shift of about 273 nm. This combination of an extended fluorescent decay time and a large Stokes shift has provided the basis for the construction of relatively simple and inexpensive pulsed-light, time-resolving fluorimeters capable of giving very high signal-to-noise ratios and providing assays with sensitivities as good as, if not better than, radioisotope-based techniques.

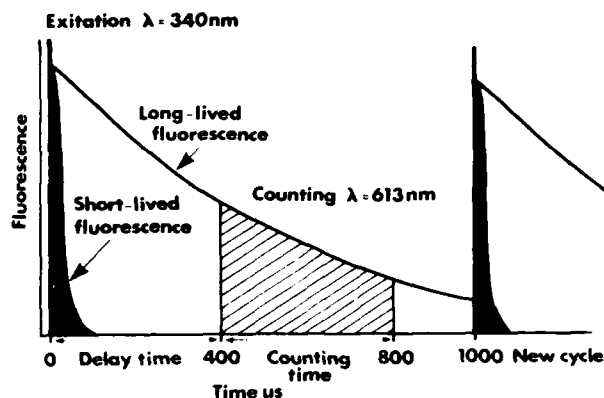


Figure 1. Selected counting of fluorescence photons after excitation by light at 340-nm wavelength.

Chemiluminescent Methods

As mentioned above, chemiluminescence is the emission of light as the consequence of a chemical reaction. It can be used to measure many biological substances in the range of 10^{-15} and 10^{-18} molar (Patel et al., 1983). The study of ligand-ligand interactions--for example, hormone-receptor or protein-metabolite interactions--is often hampered by the need to separate the bound and free constituents. Patel et al. have shown that it is possible to achieve chemiluminescence energy transfer between a chemiluminescent-labeled antigen and a fluorescent (fluorescein)-labeled antibody. In this situation, there is no need to separate the bound and free components. These so-called homogeneous systems do not present the difficulties associated with separating small volumes of solution; thus, much less sample is needed for the assay, and errors of handling are minimized.

Chemiluminescent labels can also potentially overcome the problems posed by radioisotopes (Campbell and Simpson, 1979). At the symposium, Stuart Woodhead (Welsh National School of Medicine, Cardiff, Wales) pointed out how derivatives of luminol and acridinium salts have been used to provide stable chemiluminescent labels for immunoassay. According to Woodhead, the main disadvantage of luminol-based reactions is that a catalysis is required which renders them susceptible to interference effects and to the quenching action of some proteins. By contrast, acridinium salts tend to react under mild conditions, and the quantum yield appears not to be affected by association with protein.

Woodhead told how he has prepared a hydroxysuccinimide derivative of an acridinium salt and used it to label antibodies to several polypeptides, including alphafetoprotein, ferritin, and thyroid-stimulating hormone and then used these together with appropriate solid-phase antibodies to develop two-site immunochemiluminometric assays for these analyses. In contrast to radio-labeled antibodies, these chemiluminescent-labeled ones have been stored for more than a year with no apparent loss in activity. Likewise, luminescent-labeled rabbit immunoglobulin G (RIgG) has been stored at -20°C for several months without significant loss of its immunological or luminescent activity.

It has been possible to label antibodies with acridinium esters to a much greater extent than with ^{125}I . In general, chemiluminescent-labeled proteins appear to be providing sensitivities down to 10^{-16} to 10^{-17} molar. This compares with 10^{-14} molar as the lower limit for radioimmunoassays (Ekins, 1984).

Although homogeneous immunoassays, based on chemiluminescence of steroid-isoluminol conjugates, have been found to have satisfactory sensitivity and precision, nonspecific interference from luminescent compounds in biological fluids has necessitated prior purification of the samples. Attempts have been made to overcome this problem by using solid-phase techniques involving absorption of IgG fractions of the antisera (serum containing antibodies) onto either the walls of polystyrene cuvettes used in measuring the chemiluminescence (Kim et al., 1982) or covalently coupling a purified IgG fraction of monoclonal antibody onto polyacrylamide beads. The latter technique has been reported by collaborators at the Academic Hospital in Ghent, Belgium, and at the Weizmann Institute of Science in Rehovot, Israel (De Boever et al., 1983). The sensitivity of the solid-phase chemiluminescence method as obtained by these workers is comparable to that seen with radioimmunoassay, or about 4.9 picograms. It is not necessary to use a long incubation time as it was found that 1 hour is quite sufficient.

As a result of the increased interest in chemiluminescence for immunoassays, several companies have designed instruments that are automated and extremely stable and accurate. One such company in Europe is Laboratorium Berthold in Wildbad, West Germany. Their machine, Autobiolumat LB950, has the capacity to process approximately 250 sample tubes per hour.

Conclusion

While fluorescence and chemiluminescence assay techniques are but two of several currently being studied as alternatives to radioimmunoassay, they appear to present the best chances for success. It is especially important that the US Navy move in this direction in order to eliminate the use of potentially hazardous radioisotopes. Cost should also be a driving factor, since the other methods have been shown to be more cost effective in terms of reagents, personnel, and equipment.

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8/15/84

GERMAN GROUPS CONDUCT BROAD RANGE OF RESEARCH ON POST-TRAUMA TREATMENT

by Thomas C. Rozzell.

A broad range of medical and surgical research is being conducted at the Institut für Experimentelle Chirurgie (IEC) der Technischen Universität München (Institute for Experimental Surgery of the Technical University Munich) and at the Garmisch-Partenkirchen Hospital (G-PH). These two groups cooperate very closely, with some of the staff working part time in one location and part time in the other. The head of the Munich group is Prof. Dr. G. Blumel, and the head of the G-PH team is Dr. F. Lechner. One of the most active researchers in the group is Dr. Rudolf

Ascherl, who spends about half of his time at each place.

During a recent visit with Ascherl, I found that the teams at IEC and G-PH are extremely active and engaged in four major lines of research: (1) electrical stimulation of bone, (2) implantation of limbs and joints, (3) drug delivery and artificial skin, and (4) fibrin adhesion and skin grafts. This article gives an overview of the scope of the various research programs and points out how these may be of interest to the US Navy.

Electrical Stimulation of Bone

The electrical stimulation of fractured bone has gained wide acceptance in recent years, being used primarily as a supplementary treatment for certain types of fractures that do not respond to normal orthopedic procedures. The most-studied cases involve breaks or nonunions that have not mended over a period of several months to several years. Pseudarthrosis is the most commonly treated malady in this class (ESN 38-7:360 [1984]). (Pseudarthrosis is deossification of a weight-bearing long bone, followed by bending and pathologic fracture, with inability to form normal callus leading to the existence of the "false joint" that gives the condition its name.) In the US, the most popular electrical stimulation technique, that of Bassett, is almost always given without further surgical intervention. It uses a set of external magnetic-field coils to induce electric current in the bone. The groups at IEC and G-MP also use external coils but prefer to implant pick-up coils at the site of the joint. The external solenoid coil, shaped to the region of the body to be treated, is driven by a function generator at a frequency ranging from 2 to 30 Hz. A magnetic field strength of approximately 2.4×10^3 A/m is generated by the alternating current in the external coil. Correspondingly, AC potentials with an amplitude of several hundred millivolts are generated in the implanted pick-up coil, which has a ferromagnetic core. The implants are designed to be part of the internal fixation device that is holding the ends of the fracture in place.

In addition to implantation of the pick-up coil, spongy bone is grafted into the gap of the fracture. (Spongy bone is a form of bone in which the matrix is arranged in a network of rods, plates, or tubes between which are spaces filled with marrow.) The spongy bone is more conductive than compact bone and thus better able to bridge the

fracture gap electrically. Peak electric fields on the order of 400 mV/cm are often measured in the pseudarthrotic gap. The technique used by these groups is reported to be more effective than electrical stimulation alone. More than 400 patients have been treated at the G-PH in the past 12 years, with a healing rate of about 93 percent for all types of pseudarthroses, including those with infection. On an average, the patients treated have undergone 3.6 prior surgeries, and the mean time of the nonhealed fractures is 38 months. The researchers have found that hospitalization rarely takes more than 4 weeks. After that time, the patients are able to treat themselves with rentable devices.

There is little reduction in the healing time of fresh fractures (10 to 15 percent). But when the bone is severely crushed, when there is a compound fracture, or when there is infection, this technique might significantly reduce the amount of time that injured military personnel are off duty.

Implantation of Limbs and Joints

Ascherl and others in the surgery group at G-PH characteristically implant about 850 hip joints and about 150 knee joints per year. Aseptic loosening of implanted hip joints is one of the major problems following replacement surgery. The interface between the surface of the implant and the bone resembles a nonunion and thus might be looked upon as a type of pseudarthrosis between biomaterial and osseous (bony) tissue.

For the past 11 years, Ascherl and the G-PH team have conducted a study involving more than 600 patients with cemented prostheses who were scheduled for re-operation to correct a loosening joint. They treated the patients with the same pulsing magnetic field that is being used for bone stimulation mentioned above. Adjustable and specially shaped coils were placed around the hip joints, and treatment was given 2 to 3 hours per day for an average of 15.4 weeks. The results of the treatment were measured in terms of the level and occurrence of spontaneous pain, pain while walking, use of crutches, distance of walking and dosage of pain killers required. Excellent results were obtained in 26 percent of the patients, which meant painless walking without crutches. Good results were shown by a further 41 percent of the group. There was no improvement in 33 percent, who then went on to have further surgery; some prostheses had to be reimplanted. Thus, 67 percent of the patients avoided surgery

through the use of the pulsing electromagnetic fields. The maximum follow-up has now been 11 years, and there have been no reoccurrences of loosening joints in most of the treated cases. This type of treatment seems to be indicated and most successful in cases with a painful loosening soon after implantation. Septic loosening, fractured cement, and dislocation of the implants have to remain a domain of surgery.

The G-PH group has had good success in total replacement of knee joints, a procedure that is especially important for personnel who suffer massive injuries to the legs. The restrictions on the use of experimental surgery methods and materials are somewhat less than in the US, so the researchers have been able to achieve significant strides in this area. The high incidence of injuries due to a large skiing population also contributes to the general input to the patient pool.

Drug Delivery and Artificial Skin

In military medicine it is often desirable to quickly cover a wound, minimize the chance for infection, and increase the rate of healing. Several approaches have been taken to this problem. Ascherl and coworkers have developed two types of collagen sheets that can carry drugs and can biodegrade without leaving toxic by-products. Both forms of the collagen are prepared from pure bovine collagen. One is in the form of a clear sheet, which allows one to view the wound. The other looks a bit like a sheet of styrofoam; it is white, opaque, and about 3/32-inch thick.

Both of the forms of collagen can be impregnated with drugs. The researchers have chosen to use gentamycin, a broad-spectrum antibiotic that is effective against a wide range of gram-negative bacteria as well as certain gram-positive ones. The thin, transparent material could probably be used quite well for burns. In application, it is first soaked in water for a few minutes until it becomes pliable. Then it can be placed over the wound, conforming to the contours of the body. It "breathes," so air can pass through but dirt is kept out. Although it requires the addition of external moisture from time to time, it is advantageous because it does not have to be removed--often a major problem in the course of treating burn injuries because fragile skin is often removed along with the bandage. The collagen film also provides a "bridge" for the growth of new skin.

The thicker collagen can also be used for burns and for other types of wounds, such as massive cuts or tears of

the skin. It can hold more drug and thus release it over a longer period of time. This material can also be implanted into and around bone during surgical treatment for osteomyelitis and other diseases where there is a high likelihood of localized infection. The collagen is completely resorbed by the body over a period of weeks to months, and drug is delivered during the lifetime of the collagen. Since the US Navy does not have enough skin-graft material to meet even peacetime needs, this line of research may have potential value to the tissue-bank program.

Fibrin Adhesion and Skin Grafts

Suturing surgical or trauma-derived wounds and stopping bleeding are essential elements in casualty treatment. Many complications can arise due to suture material: for example, fistulas can form, tissue around wounds can separate, and massive bleeding can occur if there are deficiencies in blood clotting factors.

A number of alternatives to sutures have been tried, the most notable being synthetic tissue adhesives based on acrylic-acid derivatives (Crazy Glue is a good example of this class of adhesive). These did not fulfill the requirements and even presented some undesirable side effects. The German groups have been working very hard on an innovative biological seal based on blood-clotting factors and a fibrinolytic inhibitor. They call the technique fibrin adhesion or fibrin gluing.

The fibrin glue consists of two components: deeply frozen fibrinogen and thrombin. The fibrin adhesion technique imitates the final step in the coagulation of blood and the beginning of the initiation of healing in wounds. In this process, fibrinogen is converted to fibrin by thrombin, and the polymerized fibrin is stabilized by factor XIII. Fibrin sticks to the tissue and the blood begins to clot. The fibrin network formed in a wound appears to act as a scaffold for the healing of that wound, attracting large migrating fibroblasts and promoting the formation of granulation tissue.

Many procedures have been tried using the fibrin adhesive technique. It was found, however, that the fibrin seal is broken down by proteolysis, and the glue dissolves faster than the tissue can repair itself. There are, however, several fibrinolysis inhibitors; when applied directly to the wound area, they protect the fibrin from premature lysis. Notable among these inhibitors are aprotinin and tranexamic acid. The inhibitor is mixed with the thrombin.

The IEC group has used the fibrin adhesive technique very successfully for teeth extractions, tonsillectomies, and other surgery on patients with severe bleeding disorders. They have used it for nerve anastomosis (rejoining of severed nerves), fixation of loosened joint cartilage and small cortical and cortico-cancellous bone fragments, replacement of large skeletal defects in combination with autologous cancellous bone grafts, treatment of skin ulcers of various types, treatment of burns, and sealing of blood vessels and intestines. Fibrin glue has also been used successfully to repair ruptured Achilles tendons, a condition appearing frequently in physically active individuals.

The fibrin adhesive technique has proven to be of tremendous value in liver, kidney, and spleen surgery. Following either surgery or traumas to these organs, the technique has been used to seal parenchymal defects. It is especially useful since suturing is almost impossible in the liver and spleen. In general, the technique of fibrin adhesion cannot replace surgical suturing; it can be a helpful adjuvant in surgery, especially in patients with bleeding disorders.

In yet another twist, the researchers have combined the fibrin glue with collagen "sponges" or foam. Fibrin has a natural affinity for collagen. The hemostyptic effect of fibrin glue in combination with collagen has been tested *in vivo* using rats treated with the anticoagulating agent coumadin. In hemihepatectomy (excision of half the liver) or laceration experiments it was found that the combination technique resulted in a lower death rate than when fibrin seal or the collagen foams were used separately.

The research group has found that when the fibrin adhesive has been used to seal various tissues, either alone or in combination with sutures, the resulting joints have a higher tensile strength than when the adhesive is not used. Use of the glue also means that sutures can be placed further apart, lessening damage due to tight sutures.

Thus, there are a number of instances in traumatology where the extensive research of the surgical teams at IEC and G-MP should prove of interest to US military medical-care units. Very little of the research is published in English-language journals. There is so much research at these two institutes that I am planning a return visit there next year.

8/21/84

EARTH SCIENCE

EUROPEAN GEOPHYSICAL SOCIETY MEETS IN BELGIUM

by Norman F. Ness. Dr. Ness is the Liaison Scientist for Space Physics in Europe and the Middle East for the Office of Naval Research's London Branch Office. He is on reassignment from Goddard Space Flight Center, NASA, where he is Chief, Laboratory for Extraterrestrial Physics.

The Tenth Annual Meeting of the European Geophysical Society (EGS) was held at the Catholic University of Louvain-la-Neuve, Belgium, from July 30 through August 3. This was a much smaller meeting than that held at Leeds, UK, in 1982, but there were still over 300 papers presented in the 12 symposia, three workshops, and one open session. Raymond Hide (UK) retired as president of EGS in August; his replacement is Michel Petit (France).

There were three society lectures: P. Tappinier (France), "Plate Tectonics of Asia"; P. Melchior (Belgium), "The Role of Tides in Earth Sciences"; and M. Nicolet (Belgium), "Solar Activity, Variations of UV and X-Ray Fluxes."

Nicolet was the 1984 recipient of the American Geophysical Union's Bowie Medal in recognition of the important role he has played for many years in cooperative international programs of geophysics, especially the International Geophysical Year (ESN 37-1:42-44 [1983]). The main point of Nicolet's talk was that the presently available data from satellites show temporal and wavelength variations that are of an instrumental origin, so that studies of secular variations in the "solar constant" cannot be done with any confidence. He recommended that the future satellite experiments must pay particular attention to this problem of cross-calibration. He also noted that some commonly used indices of solar activity, based upon ground observations, show variations that are clearly artifacts of the methodology used to generate them. He strongly cautioned against use of such parameters in any study of long-term variations of the solar emissions.

Of particular interest to future activities in space research were the Symposia S2, "Planetary Exploration and Future Planetary Missions," and S12, "First Results From Geophysics and Solar Experiments on Spacelab." The European community of planetary scientists is

small but active and participates importantly in US and USSR planetary probe missions. But there is a strong desire to pursue a more independent path and especially to take advantage of the success of the European Space Agency (ESA)-developed Ariane launch vehicle. The Giotto mission to Comet Halley (launch in 1985) reflects these points and the ESA-proposed Kepler mission to Mars continues this thrust. Professor Ulf von Zahn (Physikalisches Institut, Universität Bonn, West Germany) presented a persuasive argument for this important project, whose future will be decided in the near term, after extensive studies by ESA and its contractors. A number of Europeans are quite disappointed with the delays in the implementation of Spacelab and particularly the limited opportunities in the near future. There is also some rethinking of Spacelab and its associated experiments with respect to their overall scientific utility. The conclusions reached suggest that space research done with Spacelab may not be economical enough to merit future participation, unless funding levels increase substantially and meaningful results are obtained.

A well-attended set of sessions composed Workshop 3, "Magnetospheric Effects of Seismic Activity." A number of papers by European, US, and USSR investigators reported various experiments using both natural (earthquakes, aurora, and thunderstorms) and man-made (chemical explosions) sources which couple into the Earth's ionosphere and magnetosphere and disturb this natural environment. The USSR in particular has been very active in this area of research, as reported by M. Gokhberg (Schmidt Institute of Earth Physics, Moscow). During the flight of the spacecraft Aereol 3 in the joint French-USSR project ARKADE, a 300-kiloton surface explosion 80 km from Alma-Ata was timed to occur coincidentally with the spacecraft (S/C) passage through the magnetic flux tube connecting the S/C with the surface site. Initial data showed significant magnetohydrodynamic signals at the S/C associated with the explosion.

Observations by the French very low frequency (VLF) experiment on the GEOS 1 and 2 spacecraft and at Kerguelen Island were presented; they showed a correlation between earthquake activity and increased electric and magnetic field signal levels observed by the S/C. Future research on studies of perturbations to the magnetosphere by such natural and man-made sources will be augmented by use of spacecraft VLF sources in a USSR project.

Since this was primarily a "local" meeting, the number of non-European participants was quite small. The proceedings of the symposia and workshops will be published in a forthcoming issue of the new journal *Annales Geophysicae* (editor, S. Mueller, Switzerland).

The scientific program consisted of the following topical sessions: S1, structures of pre-Alpine orogenies; S2, planetary exploration and future planetary missions; S3, convection phenomena in geophysics; S4, experiments in solid state physics relevant to lithospheric dynamics; S5, physical processes in atmospheres, oceans, hydrospheres, and soils as revealed by remote sensing; S6, analysis of nonlinear transport processes in soils; S7, turbulence in rotating fluids; S8, long-lived eddies in oceans and atmospheres; S9A, ice-snow climate interactions; S9B, sensitivity of climate to externally imposed effects, particularly those due to man's activities; S9C, dynamical problems in climate modeling; S9D, topics in climate; S10, modeling of mesoscale processes in air-sea interactions; S11, thermosphere/ionosphere coupling at high latitudes and possible solar wind/magnetosphere influence; S12, first results from geophysics and solar experiments on space-lab; S13, solar geophysical indices revisited; W1, paleomagnetism, age dating, and sedimentology of young sediments; W2, aspects of the energy balance at the surface of the Earth; W3, magnetospheric effects of seismic activity; O1, open session of Section I, Earth and Planetary Interiors and Surfaces.

8/8/84

NERC SPONSORS REMOTE SENSING PROGRAM

by Robert Dolan. Dr. Dolan, formerly at ONR, London, is Professor of Environmental Sciences at the University of Virginia.

The UK's Natural Environment Research Council (NERC) has recognized the important role of remote sensing in the environmental sciences. Support for research and services in this area has been more than doubled in recent years--a period of substantial overall cutbacks in UK science (see ESN 38-4:213-215 [1984]). Remote sensing is part of a

division called NERC Scientific Services (NSS), which also includes data processing, research in thematic information processing, and a radiocarbon dating service.

NERC is responsible for research in the physical and biological sciences relating to the natural environment. This includes geology, hydrology, meteorology, biology, ecology, and oceanography. NERC is similar to the US National Science Foundation (NSF) in that the government supports NERC, which in turn distributes funds for research. There are differences, however. NERC not only funds individual research proposals like NSF, but also provides block support for several of its own laboratories, including the Institute of Oceanographic Sciences and the Institute of Hydrology. (On the UK research councils, see ESN 38-2:104-107 [1984]).

The NSS activities in remote sensing have concentrated on ensuring that data are made readily available to the NERC labs and researchers, providing state-of-the-art image processing facilities, and developing remote-sensing measurement methods. The facilities and services made available by NERC include: a powerful image-analysis facility operated by the Thematic Information Services (NERC at Swindon), the National Remote Sensing Centre (NRSC) at Farnborough, and the Satellite Receiving Station at the University of Dundee. (For more information about European work in remote sensing, see ONR, London, *Military Applications Summary Bulletin* 49-84 and 50-84.)

Satellite and airborne remote-sensing methods are used routinely in NERC-funded research programs over most disciplines in the environmental sciences. The following are examples of programs:

- NERC and the University of Reading are principal investigators in the US National Aeronautics and Space Administration Landsat-4 Thematic Mapper program.
- The Institute of Oceanographic Sciences has analyzed data acquired by Seasat for measurements of surface winds and waves and ocean topography. Studies are also under way on the use of high-resolution radar imagery for studies of surface slicks, wave periods, and directions and bottom topography effects.
- The UK's Marine Biological Association is using coastal zone color scanner (CZCS) data from Nimbus-7, and advanced, very-high-resolution radiometer data from US National Oceanographic and Atmospheric Admin-

istration (NOAA) satellites to study mixing processes and phytoplankton growth in the European continental shelf and shelf break regions.

- Visible and infrared images for NOAA satellites acquired at the NERC receiving station at the University of Dundee are used by the Scottish Marine Biological Association to study the physical oceanography near Scotland.
- Landsat and Nimbus-7 data are used by the Institute of Marine Environmental Research to study turbidity and environmental problems in the Bristol Channel.
- High-resolution multispectral images by Landsat are used by the Institute of Geological Sciences for studies in the UK and in developing countries. This includes the relationship of fractures to mineralization in England; Thematic Mapper studies in areas of glacial and outwash deposits and in intertidal zones; and geological mapping and mineral exploration projects in Bolivia, Panama, Peru, Egypt, Kenya, Botswana, Zimbabwe, and Malaysia.
- Studies of land-use change and vegetation mapping based on Landsat data are being carried out by the Institute of Terrestrial Ecology as part of Ecobase geographical-data-management studies (see page 575).
- Moisture measurements, water resources studies, and the potential of satellites to estimate precipitation are being investigated by the Institute of Hydrology.
- The British Antarctic Survey uses Landsat and NOAA satellites to do studies of ice-sheet dynamics, glacial and subglacial morphology, the drift tracks of icebergs, and distributions of Antarctic pack ice, as well as to prepare maps to assist field work.

NERC has a special-focus program to provide support for university research in remote sensing and to encourage university collaboration with public institutions. Projects supported in 1984 include:

- Geology--two projects evaluating the information content of multiband imagery and data from new satellites.
- Ecology--two projects studying the effects of stress on vegetation, and the spectral characteristics of vegetation canopies.
- Oceanography--two projects concerned with sea-surface temperature and studies of sediment and chlorophyll concentrations.

- Data handling--three projects on image analysis data structures and integration, and geographical information systems.

This special-focus program started in 1984 and will run for 3 years at \$130,000 per year. It's designed to encourage the development of scientists with expertise in remote sensing and data handling.

NERC also supports university research in the development and use of satellite remote-sensing techniques through the provision of grants and training awards. Examples of recent grants include: ice flow dynamics in the northern polar marginal ice zone; studies of atmospheric radiation and dynamics; visible and infrared reflectance properties of plants; estimation of vegetation amount and productivity; preparation of thematic maps using satellite data; radio-echo exploration of ice sheets and glaciers; remote sensing in geological mapping and mineral exploration; studies of phytoplankton production and oceanographic structure using CZCS data from Nimbus-7; evaluation of image data quality for the Landsat-4 Thematic Mapper; assessment of the geometric properties of simulated SPOT data including stereoscopic capabilities; soil survey by remote sensing using Landsat-4 data; and studies of the atmospheric corrections to be applied to remotely sensed data.

NERC operates a number of remote-sensing services and facilities to support the research groups, NERC institutes, and universities carrying out NERC-funded research:

- Image analysis and digital cartographic facilities at the NERC Thematic Technology Services in Swindon. The image analysis facilities have recently been upgraded and now three I²S work stations are available.
- Access to the NERC facilities at Farnborough, including access to satellite data by the UK Earthnet National Point Contact.
- The satellite receiving station at the University of Dundee, which acquires NOAA and Nimbus-7 satellite data.
- An aircraft fitted with dual aerial camera ports, both capable of taking RC8/10 aerial cameras or multispectral scanners.

The NERC's Thematic Information Service (TIS) was formed in 1982; it has the following responsibilities:

- The provision of a digital cartographic service to NERC institutes.
- The undertaking of research and development in the fields of digital cartography and spatial analysis.
- The provision of an image analysis service to NERC-funded scientists in institutes, universities, and polytechnics.
- The undertaking of research and development in the field of image analysis.
- The provision of remote sensing services using non-NERC facilities.

The major projects undertaken by TIS in 1983-84 are described below.

There is a long-term project to use digital cartographic methods to produce geochemical atlases. Field surveys and geochemical analyses are undertaken by the British Geological Survey (BGS), which publishes atlases. Each atlas contains a reference map, pH and conductivity maps, a map summarizing the geology, and geochemical concentration maps. The line data are taken from 1:50,000 Ordnance Survey maps with geology data surveyed and compiled by BGS/NERC. Final map scale is at 1:250,000. The element concentrations are shown by wind-rose symbols which radiate from the point location.

TIS is also doing an epidemiological study into the association between degenerative diseases in man and natural trace-element levels. The study area is in northeast Scotland. A computer-readable database which includes data such as the concentration of chemical elements, medical statistics, rainfall values, geology, and Landsat images is being set up. The use of such very different data sets requires a system capable of handling point, line, polygon, and raster data in an integrated and registered manner. Both vector and raster systems are employed at different stages in the investigation.

Ecobase is the name given to a computerized cartographic database developed by TIS on behalf of the Institute of Terrestrial Ecology. It was created by digitizing selected topographic features from Ordnance Survey 1:250,000 scale maps.

A project for the Institute of Hydrology involves the design of a program to digitize and then rasterize maps of soil type, design and program of a package to allow digitizing and interactive editing of soil boundaries and points, and design and implementation of a program to apply a bilinear transformation to the data as an approximate method of changing projection.

Another TIS project was a review and demonstration of methods by which the data collected by various forms of sonar devices, as well as by airborne and satellite remote sensing, could be optimally portrayed on maps and charts. Work is now being done with the Institute of Oceanographic Sciences to establish methods of registering digital sonar data sets derived from different sources, including GLORIA data.

The first full year for a specially established NERC Cartographic Research Group was 1983-84. The rapidly developing potential of digital cartography, spatial analysis, and image analysis and the importance of the associated techniques to NERC science led to the establishment of this research team. The research program has concentrated on the design of an integrated geographic information system.

Software has been developed which allows the transfer of any of TIS's large archive of digital map data to the image processing system. The goal is to convert all spatial data, regardless of the method of data capture, into registered raster files. The current system does not provide the user with a single processing environment, and error analysis is difficult. Because of this, the current system for handling and integrating vector and raster data is too complex and cumbersome to encourage widespread use by the applications scientist. Research has therefore concentrated on the design of a single user-oriented system for the spatial analysis and modeling of combined vector and raster data sets. This provides a framework within which the other research projects fall.

NERC has been acquiring digital thematic and topographic map data for over 15 years. It now has several hundred megabytes of spatially referenced vector data of the UK and continental Europe. For these data to be used efficiently with other data sets for spatial analysis, modeling, or mapping, there must be a logical way of storing and retrieving the data. However, the current data structures and methods of handling the vector data are becoming outmoded. TIS is being asked to carry out more elaborate spatial data processing using larger data sets. Recent projects, for instance, have required extensive statistical analysis and integration with other geographical data sets. For these reasons, researchers reviewed the databases suitable for holding the cartographic data on the computer network at the Science and Engineering Research Council. The Honeywell/Codasyl IDS-2 database manage-

ment system was recommended by the NERC Computer Services; it was mounted on the NERC Honeywell.

While the NERC database is considered necessary for efficient data storage and management of the combined vector cartographic data sets, NERC feels there is an urgent need for a database for the efficient spatial processing of integrated vector and raster data. This is a major research goal for TIS. The problem is not only to identify a data structure suitable for holding all forms of spatial data (raster, points, lines, polygons), but also one suited to an efficient, spatially correct addressing system. During 1984 that research began by considering the spatial requirements for processing geographical data.

A significant advance has been the development of a new arithmetic, called tesseral arithmetic, which allows for the efficient manipulation of spatial data sets--regardless of where on the Euclidean plane the data lie. Tesseral arithmetic operations on the tile addresses very efficiently implement transforms in the geographical data, such as translation, scaling, and rotation. Although this addressing and arithmetic are being developed in software, they could potentially be implemented directly in hardware, offering the possibility of super-efficient spatial processing. The research is not examining the arithmetic applicable for processing data sets of more than two dimensions. Although the research to date has been mainly theoretical, a test database is being developed with both vector and raster data mapped into a quadtree structure and using tesseral addressing. Joint research in this subject and its application to image classification will be carried out over the next 3 years.

8/17/84

SYMPOSIUM ON CLIMATE AND PALEOCLIMATE OF LAKES, RIVERS, AND GLACIERS

by Robert Dolan.

The glaciers are melting, the glaciers are melting!

That was the conclusion I reached after listening to two-thirds of the papers at the Symposium on Climate and Paleoclimate of Lakes, Rivers, and Glaciers, held at Igles, Austria, from June

4 through 7. Although lakes and rivers were part of the program, glaciers were the topic of greatest interest, represented by three-fourths of the papers. Most of the research was based on the analysis of ice cores, terminal moraines, or change mapping using aerial photography.

Many of these investigations are efforts to fine tune the Pleistocene-Holocene chronology using site-specific data. Most of the papers offered a tabulation of dates for Wisconsin glaciation and post-Wisconsin melt; the differences in some cases would appear to be within the error term for the methods. Nevertheless, there is good correlation of glacial-postglacial states for glacial sites around the world; that is, plus or minus 2000 years or so. For the beginning of the Holocene the dates presented ranged from 15,000 before the present (BP) to 11,000 BP, with 6000 BP to 5000 BP for the end of the North American-European glaciation.

What did appear new (to me anyway) was the importance of the Milankovitch cycles (ESN 38-8:429-430 [1984]) and the possible role of topographic change associated with plate movement. Topography alone may have been responsible for major climatic change over the past 1 million years.

Back to the melting glaciers. At least 15 of the 60 papers offered evidence of recent recession of the world's glaciers. All of New Zealand's glaciers have been receding and thinning since 1869; Norway's glaciers are melting at a rate of about 20 m/yr (recession) and 1.5 to 3.5 m/yr surface reductions; and similar data were presented for the glaciers of East Africa, Greenland, South America, Switzerland, and North America.

My favorite papers included one analysis of a 125-m core from a "cold" glacier in the Alps that could be dated back about 1000 years. The core included annual dust layers associated with Saharan Desert dust storms, as well as stratification of CO_2 . Since the early 1900s the level of CO_2 increased by an order of magnitude, but it has been decreasing sharply since 1977. The other paper that I particularly enjoyed was presented by R.G. Craig (Kent State), "Glacial Climate of the SW United States; A Computer Model." Craig modeled runoff volume during the Wisconsin glacial era at a very fine level of detail, using equations that relate global changes to local wind patterns. Strong orographic influences in the southwestern US, coupled with the dominant Pacific air mass, combine to make the southwest an ideal area to develop

such equations. He defined 41 variables that combine to describe the western orographic climate. Each of these is solved at each point of a large detailed grid covering the area and can be determined independently of local climate. Solutions require the elevation at each point, including detailed bathymetry of the Pacific coast, sea-surface temperatures, and the amount of sea-level lowering during the Wisconsin. The final variable needed was the dominant regional wind direction across the area, which was obtained from General Circulation Model solutions using CLIMAP boundary conditions.

Craig defined the variables so that each reflected some influence of the global climate change. For example, one variable describes for each point the sea-surface temperature at the coast where the dominant wind vector passes inland to cross that point. Another variable describes the maximum elevation crossed by that wind vector before reaching the point. The third influence is illustrated by a variable measuring the distance from the coast to that point along the given wind vector.

Each of these reflects global climate change in a different way. Sea-surface temperature changes may change values of variable one at all points. Wind-vector direction may change the values of all three variables at all points. Sea-level changes modify the value of variable three at all points. All 41 independent variables reflect one or more of these fundamental changes. Because all changes occur synchronously, the combined changes are complex.

Using modern climate-station data, Craig constructed a set of equations that predict climate from the 41 independent variables. He modeled both mean temperature and mean precipitation for each month. The temperatures were used with the Blaney-Criddle equation to estimate evapotranspiration. This he subtracted from precipitation to yield monthly runoff values.

Predictions of modern runoff were then tested by evaluating the sizes of lakes that are created. The lakes match the actual modern landscape configuration. When the same equations were solved with boundary conditions of the Wisconsin glacial maximum, the resulting lake configurations corresponded very closely with the geologic record. The climatic predictions themselves also agree with the geologic record.

Craig said that the implications of these solutions suggest that the changes in climate are much more variable spatially and temporally than previously recognized, and that the southwestern

fluvial system may have taken hundreds of years to adjust to post-Wisconsin climatic changes.

One final observation. I was surprised that there was no discussion of the recent predictions of increases of CO₂ and of the implications relative to lakes, rivers, and glaciers--nor did the subject of a rapid rise in sea level come up during the symposium.

The proceedings of the symposium are available from the International Commission on Climate, UNESCO, Paris, France.

2/81/84

ELECTRONICS

VLSI AT THE AUTONOMOUS UNIVERSITY OF BARCELONA

by J.F. Blackburn. Dr. Blackburn was until September the Liaison Scientist for Computer Science in Europe and the Middle East for the Office of Naval Research's London Branch Office.

Research on very large scale integration (VLSI) at the Autonomous University Barcelona, Spain, includes work on a logical circuit recognizer, an integrated-circuit rules checker, and a silicon compiler.

Logical Circuit Recognizer

The circuit complexity of VLSI technology poses two main problems for circuit designers: classical theories and design methods are obsolete, and the circuit cannot be modified after integration.

To reduce the impact of these problems, extensive pretesting is required and may include most of the following steps: (1) design-rules checking to detect violation of technological restrictions, (2) use of a simulator for cases of possible conflict in the electrical circuit, and (3) a global simulation.

The Autonomous University of Barcelona has designed a logical circuit recognizer (LCR) for negative metal-oxide-semiconductor technology that accepts data from any electrical circuit scheme. It loads a database, identifies the logic gates of the circuit, and estimates the switching times in order to prepare the input to a logical simulator.

The LCR accepts as data any electrical scheme coming from an electrical circuit extractor. It then loads the coordinates of the transistors on a database to help establish relations between the elements of the circuit. The next step is to identify the different logic gates of the circuit and compute an estimate of switching times in order to prepare the input to a logic simulator. Finally, the LCR returns: (1) information about the circuit logical gates--their interconnections and switching times, and (2) a logical electrical scheme in accord with the electrical circuit topology.

The system has been tested with small circuits. For a circuit of 65 transistors, the central-processing-unit time on a VAX 11/780 was 79 seconds.

Integrated-Circuit Rules Checker

In another project, a design-rules verification process for integrated circuits was devised. To generalize the process, a design-rules description language (DEREDIC) and its compiler have been implemented. The compiler generates a code that is used by a basic rules checker, VERDICT, to validate the integrated circuit. To overcome certain VERDICT limitations, a hierarchical, structured, general checking process called VERI was designed.

The steps in the design of an integrated circuit include: developing a functional description, defining architecture, determining a logical scheme, determining an electrical scheme and a geometrical scheme with a set of masks, building a prototype, and testing the circuit.

The compliance with the design rules must be exhaustively checked for each of the steps in the process. The design rules must check for mechanical problems such as mask misalignment errors introduced by chemical processes, and errors due to electrical causes.

The purpose of the checking method developed at Barcelona was to generalize the validation process with respect to different technologies and to avoid constraints resulting from evolution in technologies. The language DEREDIC permits description of the technology constraints, and the language compiler analyzes the constraints and generates intermediate code. This code is used by interpreter programs to check any integrated circuit designed using this technology.

In the basic rules checker, VERDICT, the integrated-circuit drawing is considered as a rectangular network of R rows, each with P pixels. A window is defined in the network which has a test

matrix of 4 pixels. The window is moved over the circuit drawing so that every pixel will appear four times in the test matrix. Using the concepts of distance between bounds, the design rules are locally tested. The size of the window is a variable. There is redundancy in the VERDICT process; every picture is digitized every time it appears and is checked each time it appears. This increases the time and hence the cost of checking.

The VERI system takes advantage of the fact that access patterns to a figure are like access patterns to a procedure in a high-level language. The VERI system requires only one hierarchical checking of each figure in the circuit, and it reduces information kept on checked pictures to only the bounds between adjacent pictures.

A Silicon Compiler Project

The main aim in the design of an integrated circuit is to obtain a set of masks needed for its fabrication. The object of the silicon compiler project at Barcelona is to improve the process by increasing integration density and reducing the design cost.

A top-down approach is being used in the design of the silicon compiler; the circuit's topological structure is defined hierarchically according to presently available evaluation procedures. The first evaluation procedure sketches a first distribution of the circuit by blocks corresponding to different architectures and permits selection of the most suitable one. In subsequent steps, further evaluations are made, and finally the masks circuit is generated.

Functionally the silicon compiler proceeds as follows:

1. Starting from a block-oriented functional description of the circuit, the allocation, size, and relations between blocks are determined in an interactive way.
2. Parameters are computed in the next phase. A first call to each module returns its real size and an approximate value of its inputs situation. A module input includes the circuit inputs and outputs, clock signal, and power signals. Bounds are dynamically evaluated so that they are redistributed each time an input is allocated. The block transparency, indicating the number of metal tracks that pass through it, is dynamically computed.
3. If in a particular circuit the most difficult problem to solve is the interconnections layout, an interconnection network will be designed first, and the active elements will be inserted into it.

4. Masks corresponding to every block are generated by executing the generation routines with the parameters obtained.

The description language is similar to PASCAL. It contains a module declaration part and an execution part. Modules may be overlapped and can be internal or external. An internal module has to be previously defined in its declaration part. An external module is defined independently and is in an external data base. The module declaration consists of an identifier and an input/output list with their relations expressed as formal parameters. A module consists of other modules, equipotential lines connecting inputs and outputs, and segments of programs to generate masks.

Although the work at Barcelona in VLSI is similar to work carried on at other locations, it appears to be of good quality and contains some original concepts.

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8/8/84

GENERAL

MOD CHANGING UK'S DEFENSE POLICY

by Chester McKinney. Dr. McKinney, formerly at ONR, London, is Senior Research Scientist at Applied Research Laboratories, The University of Texas at Austin.

The recent publication of the latest UK Ministry of Defence (MOD) White Paper has prompted considerable discussion in the news media and certainly among the parties involved (military, civil service, and industry). The report is extremely well written and makes for interesting reading. Not only does it present the facts and figures,

but it clearly describes the plans for reorganization and the resultant trends to be expected. Many of the changes are in place, and the trends are evident. (See also "The UK MOD Announces the Results of Reorganization and New Top Appointments," *Military Applications Summary Bulletin* 51-84 [ONR, London, 8 August 1984].)

The defense budget for 1984-85 is about \$17 billion, with 19 percent for forces pay, 5 percent for forces pensions, 11 percent for civilian pay, 19 percent for buildings and miscellaneous stores and services, and a big 46 percent for equipment. This last category has increased from 34 percent during the past 9 years. It is of interest to compare the UK defense budget with those of the US and several major European countries:

Country	Budget (Billions)	% of GDP	Per Capita
US	\$225	6.9	\$962
UK	24	5.4	435
FRG	22	3.4	364
France	22	4.2	396
Italy	10	2.8	181

The UK's naval general-purpose combat forces take nearly 15 percent of the budget (about the same as the army and less than the air force), while R&D takes about 12.3 percent (all three services).

A major effort is being made to reduce shore-based activities and to augment combat forces without any overall increase in personnel or funding. The target is to reduce the number of men employed ashore by 25 percent between 1981 and 1988 and a further 15 percent during the following 5 years. Three shore establishments will be closed by the end of 1985 and other closures are planned. The savings will allow the Royal Navy (RN) to keep eight ships in the operational fleet which otherwise would have been placed in stand-by status in 1986. This will be an impressive accomplishment if it is in fact achieved. The reduction in civilian manpower for all of MOD has declined from 320,000 in 1964 to 200,000 in 1984, and the trend will continue.

It is obvious how much of this reduction in civil service numbers is being accomplished. For example, the Royal Ordnance Factories are being privatized, and this will transfer 18,500 posts outside the civil service. Cleaning and catering at shore establishments will be done on a private-contract basis. Professional and support staffs in the Admiralty research and develop-

ment establishments are being reduced (see next article). It is not entirely obvious that these changes will really result in a reduction in costs unless functions and projects are reduced or eliminated. For example, Admiralty Research Establishment (ARE)-Portland--formerly the Admiralty Underwater Weapons Establishment--used to do most of its research and exploratory development in-house. Now it contracts for at least half of this work (with industry and universities), and the extramural share is scheduled to increase. One question is whether a man-year of research costs less in industry than in a government establishment. Evidently the MOD thinks that the cost in industry is less.

Another major change in MOD policy is the increase in competition in the procurement of equipment. In the past the RN has had preferred contractors for various platforms and types of equipment; for example: Plessey for sonars, Marconi for torpedoes, and British Aerospace for mines and much mine-counter-measure gear. Typically the preferred contractor was involved in the exploratory development phase (concept demonstration), concept formulation, and prototype design and fabrication. Furthermore, the same preferred contractor would have the production contract. The process from research and development to introduction into the fleet was fairly smooth and continuous. Now all of that has changed, with sole-source contracting to become increasingly rare.

A recent example concerns the development and procurement of a new naval mine. ARE-Portland had conducted research and exploratory development, including demonstration hardware and trials, for several years. A former preferred contractor had been heavily involved in this phase of the program. I believe that the intention had been for this contractor to proceed with prototype development. However, the Minister of Defence decided that the project should be competitive. Some 19 companies were provided with the requirements and background information, and were invited to make detailed feasibility studies at their own expense and submit proposals. Approximately 6 months are being allowed for this phase. I understand that three or four UK companies are participating in this phase. The MOD/RN will then select from one to three of these proposals, and fund them for a period of a year or longer to develop their proposals, including demonstration hardware. At that time the MOD/RN will select one company to proceed with full development and production. Between each phase, significant

time must be scheduled for a careful and balanced evaluation of the work of each competitor. This new plan has some obvious good and bad features. The time to develop a piece of equipment surely will increase, and the cost of development (up to the point of production) is likely to be increased. An advantage is that the MOD/RN may get better concepts and better products. I doubt that the overall costs will be any less than with the old plan, but the MOD claims that savings of 30 percent have been achieved.

Many of those in industry are not very happy with the new plan. They must now be prepared to submit proposals on a larger number of projects. They must assemble design experts for a variety of military systems and must be prepared to invest significant company funds in each proposal. "Selling" is an important factor, and they must become especially skilled in the art of writing proposals which respond properly to all requirements. Companies are especially concerned over some recent procurement-policy changes in which it appears that one company might have to turn over to a competitor technical information which, at least in part, may have been obtained with private company funds. Another major concern is the plan to have "second source" as a standard policy. Some companies feel that military-equipment production runs are never very large and that dividing the work among two or more producers will increase the unit cost and decrease profits.

It will be interesting to observe the results of the new policies and the degree to which they will be truly implemented. The policies are in place, but there is considerable opposition from industry and some foot-dragging by some of those in government offices and establishments. Most of the UK policies are very similar to US policies which have been in place for several years. It is interesting to compare the UK plan with French policies. The French MOD does quite a bit of its R&D in-house but contracts with industry for about 50 percent. The preferred-contractor arrangement is the norm, and there is very close collaboration between MOD laboratories and contractors. Furthermore, there seems to be a policy to have a single, strong French company for a given type of military equipment. For example, recently Sintra Alcatel merged with the Division Activities Sous Marine (DASM) of Thomson-CSF to form Thomson Sintra ASM (see ESN 38-7:403-407 [1984]). This company now has a virtual French monopoly on sonar, torpedoes, mines, and mine-countermeasure gear. There will be little national competi-

tion. I suspect that one reason for the merger was to have a stronger position for international sales.

The changes I have discussed are just a few of many either implemented or in the proposal stage. Centralization of offices and functions in the UK's MOD seems to be an overall theme. A principal objective is to draw a cleaner distinction between the formulation of advice on operations, defense policy, and resource allocation on the one hand, and the management of defense resources on the other. A combined Defence Staff will be created, responsible to the Chief of the Defence Staff and the permanent Undersecretary of Defence. The Chief of the Defence Staff will be responsible for the preparation for and conduct of all military operations and not just, as at present, those involving more than one service. In the future, the principal concern of the Service Chiefs of Staff will be the oversight of the management of their individual services. These are radical changes for the MOD and military.

The MOD White Paper--*Statement on the Defence Estimates 1984*, Vol. 1 and 2, B4 and B4.50 respectively--is available from Her Majesty's Stationery Office, London.

8/16/84

UK ADMIRALTY REORGANIZES R&D

by Chester McKinney.

The preceding article discusses some of the recent and planned changes in the UK Ministry of Defence (MOD) policies. These changes have been accompanied by a number of sweeping organizational changes, some of which have been implemented during the past year, with others yet to come. I will describe some of these changes which concern the Royal Navy (RN), and, more specifically, undersea warfare.

On April 1, three Admiralty research establishments were consolidated to form the Admiralty Research Establishment (ARE) with headquarters to be at Portsmouth near Portsmouth (ESN 38-6:346 [1984]). The activities were:

1. Admiralty Surface Weapons Establishment, Portsmouth. Head: Mr. Ian Bott. Surface ship sensors and weapons.
2. Admiralty Underwater Weapons Establishment (AUWE), Portland (near Weymouth). Head: Dr. Eric Risness. About 1100 employees. Surface ship and

submarine sonar (active and passive), torpedoes, mines and mine countermeasures, and ocean science and surveillance.

3. Admiralty Marine Technology Establishment (AMTE), headquarters at Teddington (near London), but with four major locations.

a. Teddington. Head: Mr. Alex Mitchell. Acoustic echo structure, signature reduction, structures, and human factors.

b. Haslar, (near Portsmouth). Head: Dr. R. Burcher. Hydrodynamics and engineering.

c. Holton Heath, Wareham (near Poole). Head: Dr. N.J. Wadsworth. Anechoic coatings, materials, life sciences.

d. Dunfermline, Scotland. Head: Mr. E.C. Tupper. Structures.

In general, these four laboratories are concerned with research and exploratory development pertaining to platforms (surface ships and submarines) and not to weapons systems and sensors. Under the new organization the four former AMTE activities report directly to ARE headquarters at Portsmouth. Alex Mitchell, formerly Director of AMTE, retired in August.

The reorganization brings all of the RN laboratories involved in undersea and surface warfare under one umbrella. These activities are involved only in research and exploratory development (equivalent to the US Department of Defense 6.1 and 6.2 funding categories). Advanced engineering, system development, and procurement are all handled by the Director General, Warships. Each establishment is designated by its location--e.g., ARE-Portland. As of August there had been no physical relocations of people or projects, but a study was in progress (chaired by Mr. Dennis R. Hiscock) to recommend forms for reorganization of ARE--which may involve some shuffling, including eventually some closures of locations. It is clear that ARE staffs are shrinking in numbers, with a parallel increase in extramural contracting for research and development.

Ian Bott became Director of ARE at the time of its establishment in April. Bott, 52 years old, has been in the civil service since 1960, with much of his experience being in the fields of radar, optics, and electronics at the Royal Signals and Radar Establishment, Malvern. He has held a number of high-level positions in the MOD organization. Bott also serves as head of the ARE-Portsmouth activity. The ARE

Deputy Director is Dr. Risness, who also serves as head of ARE-Portland. Risness for many years has been involved in undersea and surface warfare research and development for the MOD, mostly at Portland and Portsmouth. Most recently he served as Director General, Surface Weapons.

In a way the current reorganization of the Admiralty research establishments is the latest phase in a trend which started in the late fifties. AUWE was formed in 1959 by combining the Torpedo Experimental Establishment, the Underwater Countermeasures and Weapons Establishment, and the Underwater Launching Establishment and moving them into the buildings of the Admiralty Gunnery Establishment at Portland. In 1960 the Underwater Detection Establishment, located within the Portland Naval Base, was added to AUWE (but remained in the same location, which is one of the current ARE-Portland locations). In 1975 the Aircraft Torpedo Development Unit moved to Portland. In 1975 the old Admiralty Research Laboratory (ARL) at Teddington was dissolved to form (together with a number of other activities) the AMTE. At that time the sonar and oceanography groups of ARL moved to AUWE at Portland. The present regrouping would seem to be the final one in terms of consolidation of Admiralty research organizations, but details of the intramural structure are sure to change--and soon.

The other major change took place on 1 August 1983, when the Sea Systems Controllerate was totally reorganized. The Controllerate has the responsibility for systems development, procurement, and acceptance of naval ships and equipment. In the old organization the Controller of the Navy (C of N) senior management was divided between the Director General, Ships, and the Director General, Weapons. The new organization is designed to treat the total warship--including weapons, sensors, and communications--as a primary unit of managerial accountability from cradle to grave. Under the C of N is the Deputy Controller, Warships (DCW), who is responsible for management of design, procurement, and support of warships--including the integration of all weapons and other equipment, on a total system basis, from endorsement of the Naval Staff Target until final disposal at the end of the vessel's service. DCW is responsible for Action Information Organizations. The Deputy Controller, Warship Equipments (DCWE) has a similar responsibility for weapons, sensors, communications, and marine engineering

equipment. There are several other directorates under C of N, including the Director General, Future Material Projects (Naval), who is responsible for long-range planning for ships and equipment. Mr. P.W. Jarvis is DCW and RADM J.E.K. Croydon is DCWE. Under DCW there are about 10 directorates, including Director General, Surface Ships, RADM M.A. Vallis; and Commodore Naval Ship Acceptance (CNSA), Commodore J.W.F. Briggs. Both of these offices are at Foxhill, Bath. The latter includes weapons systems acceptance, formerly known as Captain Underwater Weapons Acceptance (CUWA). CNSA is comparable to the US Navy's Operational Test and Evaluation Force, except that in the UK CNSA is involved in a project from the initiation of development through final acceptance and not just at the time a system starts trials. The former CUWA was a tenant at AUWE (Portland), and I believe that some of the offices are still there. DCWE has six directorates, including the Director General, Underwater Weapons (DGUW). DGUW, Commodore Chris L. Wood, is located also at ARE-Portland, as a tenant. More details on the organization of C of N can be provided upon request.

Because of my interest in underwater acoustics and undersea warfare, I have had more contact with ARE-Portland and DGUW than with any of the other components of ARE and DCW. Since there are many US visitors to these groups and because there have been a number of changes in staffing due to retirements and reorganization, it may be of interest to list some of the key personnel.

As noted earlier, Dr. Risness is head of ARE-Portland. He replaced Mr. Ian Davies, Director of AUWE since October 1975, who retired in March, just prior to the reorganization. Dennis Hiscock served as acting ARE Deputy Director until Risness took office on June 1. At present the four research departments are the same as before, with Dr. David Leadbeater heading the Sonar Department. Mr. Sam Mason, who had been head since 1976, retired last spring. Dr. John H. Foxwell, who came to AUWE in 1981, heads the Marine Science and Engineering Department (which includes surveillance sonar). Miss E.A. (Betty) Killick had headed the Weapons Department (primarily torpedoes) from 1976 until her retirement earlier this year. She was replaced by Dr. Colin E. Pykett. Hiscock continues to head the Assessment and Mine Warfare Department, a position he has held since 1979. Within DGUW, Mr. Doug White heads Weapons (mines, mine countermeasures and diving). Mr. Noel

Reynolds heads Sonar, and Captain Keith Eaton heads Torpedoes. More details of the organization can be provided on request.

8/20/84

MATERIAL SCIENCES

WELDING RESEARCH AT BRITISH STEEL CORPORATION

by Kenneth D. Challenger. Dr. Challenger is the Liaison Scientist for Materials Science in Europe and the Middle East for the Office of Naval Research's London Branch Office. He is on leave until May 1986 from the Naval Postgraduate School, where he is Associate Professor of Materials Science.

British Steel Corporation (BSC) has consolidated its research activities. Steel-making-process research is performed at the Teeside Laboratory; strip products research at the Welsh Laboratory (Port Talbot, Wales); and other product research at the Sheffield Laboratory. The Welding Branch moved from the Teeside Laboratory to the Sheffield Laboratory in 1983. Only Mr. Alan Clark, Manager of the Welding Branch, chose to move; the other 22 members of the Welding Branch left British Steel for other jobs. Clark has re-established the Welding Branch partially with new hires and partially by transfer within the Sheffield Laboratory.

Line-Pipe Steel

The Welding Branch plays a very active role in the production and quality control of those steel products which require good weldability (mainly line-pipe and offshore structural steels). The line-pipe steel sold by BSC is a micro-alloyed, low-carbon steel containing boron and titanium--boron for hardenability and titanium to scavenge impurity elements in the steel that might tie up the boron.

Every line-pipe quotation must be approved by the Welding Branch, ensuring that the customer's specified composition will meet the weld metal fracture-toughness requirements (also specified by the customer). All of BSC's line-pipe is manufactured by submerged-arc

welding (SAW), and the weld metal fracture toughness must meet the customer-specified crack tip opening displacement and Charpy V-notch impact energy. Typically these measurements of fracture toughness must be performed at -50°C . The actual temperature specified has been decreasing continuously as improvements in line-pipe steel making have occurred around the world. (It appears that the pipeline companies are playing one steel maker against another to pressure them to improve their steel.)

The weldability of the structural steels used for offshore platform construction is extremely important. Increasing the raw material costs in order to improve weldability has an almost insignificant effect on the overall cost of an offshore platform. The cost of the structural steel is less than 1 percent of the total cost of the platform, whereas a large fraction of the total cost is associated with fabrication, which is largely welding.

In pipelines that must operate in sour (H_2S) environments, these steels often fracture in service due to hydrogen-pressure cracking. The cracking is associated with the elongated manganese sulfide inclusions found in all steel (ESN 38-10:538-541 [1984]). A calcium addition to the steel on the order of 0.003 percent modifies the shape of these inclusions, improving the resistance to hydrogen cracking. However, the resistance to brittle (cleavage) fracture is decreased; that raises the fracture appearance transition temperature (FATT, the approximate temperature at which the fracture mechanism changes from ductile to brittle), and makes it difficult to meet the customer's fracture-toughness requirement. For example, 0.003 percent Ca added for inclusion shape control to BSC's line-pipe alloy raises the FATT from about -60°C to 0°C . It is worth noting that Peter Hart (The Welding Institute, UK) disagrees. He believes that Ca is not responsible for this shift in FATT, but that when Ca is present a higher nitrogen content in the weld metal usually occurs, and this higher nitrogen causes the increase in the FATT. If this is true, then better shielding when welding the Ca-treated steels may solve the problem. However, BSC only uses the Ca treatment when the steel is certain to be used in sour environments and avoids Ca treatment for all other applications.

Materials Testing

The Sheffield Laboratory has adequate facilities for materials testing and characterization and for welding

research. However, the only unique capability at Sheffield is the 1-MeV electron microscope. The Welding Branch is concerned with the SAW process almost exclusively as it is used for the production of the line-pipe. The welding laboratory has a three-wire tandem SAW welding machine with a four-wire machine on order. Most of the 22 people in the branch are actually involved with making and testing welds for the production facilities. They make and test all qualification welds for the line-pipe and offshore structural steels. Consequently, very little research is actually performed.

The UK navy has just placed contracts with BSC's Welding Branch to develop new consumables for welding HY-80 and HY-100 steels; the work is to include an evaluation of whether preheating is required to avoid hydrogen-assisted cracking (HAC, a different mechanism from hydrogen pressure cracking) subsequent to welding of these HY-series steels. Clark is against preheating and feels that this research program will prove that it is not required. The Welding Branch is also beginning to study why plate thickness influences the susceptibility to HAC. Previous work has shown that a plate thickness of 10 to 15 mm resulted in more HAC than thicker or thinner plates. The explanation for this no doubt involves the effect of plate thickness on the distortion and residual stresses resulting from welding.

Fundamental Research

Unfortunately, at present there is really only one fundamental research program on welding in the entire Sheffield Laboratory. Dr. G. Thewlis has the distinct privilege of performing this research. It is widely accepted that good weld-metal toughness is associated with a specific microstructure in low-alloy structural steels. For SAW the specific features in achieving the required microstructure are the use of: (1) a basic flux; and (2) the alloying elements Ti, Mo, B, C, Mn, Al, and Si to provide the necessary hardenability and continuous cooling transformation characteristics. In addition to these alloying elements, a critical oxygen content is required. However, dioxiding elements--such as Al, Si, and perhaps Ca diluted in the weld pool from the parent metal--can exert a marked effect on the critical oxygen content. Nitrogen either picked up during welding or originating as an impurity from the parent plate must be kept at very low levels in order to achieve the required weld-metal

toughness. A complex interaction between Ti, Al, Si, and B with the dissolved O and N results in the formation of large numbers of inclusions in the weld metal. These inclusions also play an important role in determining the final weld-metal microstructure as they can pin austenite grain boundaries and act as nucleation sites for the austenite-ferrite transformation, both of which affect the final microstructure.

Using one of the most careful microstructural analyses I have ever seen, Thewlis has recently completed an investigation of the effect of nitrogen on SAW weld-metal microstructures. His analyses involved beautiful optical microscopy, scanning electron microscopy, high-voltage (1-MeV) transmission electron microscopy, scanning Auger electron analysis, and scanning transmission electron microscopy. Nitrogen is known to raise the FATT and lower the upper-shelf impact energy in ferrite, but the effect of nitrogen is even more damaging to steels containing boron. Thewlis used BSC's line-pipe steel alloy (a steel microalloyed with B and Ti) for his investigation of the role of nitrogen.

Thewlis has confirmed that nitrogen increases the FATT and reduces the upper-shelf impact energy for this alloy; by very careful quantitative microstructural characterization he has shown that these changes can be explained by subtle differences in the microstructure (steels containing 0.006 and 0.009 percent nitrogen were compared). These differences would go unnoticed without quantitative optical and electron microscopy.

High-voltage electron microscopy and scanning transmission electron microscopy revealed the presence of extremely small, face-centered-cubic, boron-nitride particles. These particles are dispersed in a cellular arrangement which coincides with the prior austenite grain boundaries of the weld metal. The number density of these particles increases with increasing nitrogen content, which results in a smaller cell size (i.e., smaller prior austenite grain size) for the higher-nitrogen-content weld metal. (Although the formation of boron nitride has been postulated for some time, this is, to my knowledge, the first experimental evidence for its formation in boron-containing weld metal.) These boron-nitride particles are frozen into the solidification substructure. The mechanism proposed by Thewlis for the damaging effect of nitrogen in this steel is as follows. The nitrogen reacts with boron, forming boron nitride and reducing the soluble boron--thus

lowering the hardenability of the weld metal. The resulting boron-nitride particles: (1) restrict the austenite grain growth, causing finer austenite grain size and reduced hardenability; and (2) assist the nucleation of ferrite, which increases the austenite-to-ferrite transformation temperature as the nitrogen content increases. Both effects of the particles increase the amount of grain boundary ferrite at the expense of intragranular acicular ferrite, exacerbating the damaging effect of nitrogen on the fracture toughness of ferritic steels.

Thewlis plans to use this same experimental approach to study the effect of calcium on the fracture toughness of ferritic steels. Perhaps between his study and one under way at The Welding Institute, the mechanism responsible for the poor fracture toughness of welds in calcium-treated ferritic steels will be conclusively determined.

In summary, very little research on welding is taking place at BSC at present. However, the research that is active is of high interest to the US Navy since the results are germane to the development of new, weldable, high-strength, low-alloy steels; to the improvement of productivity using existing materials; and to the development of new SAW consumables that will allow the heat input to be increased while still maintaining the required fracture toughness and strength of the weld metal.

8/22/84

OPERATIONS RESEARCH

TIMS MEETS IN COPENHAGEN

by Robert Machol. Dr. Machol is Professor of Systems at Northwestern University's J.L. Kellogg Graduate School of Management.

The Institute of Management Sciences held its 26th biennial meeting in Copenhagen from June 18 through 20. This was the largest non-US meeting that TIMS has had, with slightly more than 700 registrations. About half of these registrants were from the US, with the remainder mostly from Europe--although 25 countries were represented, including both Chinas and several other Asian countries.

The plenary address was given by Dr. Ralph E. Gomory, one of operations

research's most distinguished scholars. In recent years he has abandoned scholarly publication in favor of his duties as director of research for IBM. Comory discussed the evolution of digital computers over the remainder of this century. His predictions were both specific and optimistic. He cautioned that these predictions were all "surprise-free"--that is, made without taking into account future breakthroughs or technical limitations. He predicted that individual components on chips would continue to get smaller and smaller; for example, storage density, now at 10^7 bits per square inch, will reach 10^8 in the early 1990s, and the number of transistors on a central-processing-unit chip will reach 10^6 in about 1989. These advances will be achieved not through breakthroughs, but through continuous hard work and engineering development; and since miniaturization is the secret behind technological advances in digital hardware, speed would continue to increase and costs would continue to come down. Thus, typical work stations in the 1990s will have the capability for 10 million instructions per second (MIPS) and minicomputers more than 500 MIPS. Furthermore, increasing speed and storage capacity would mean that more complex programs would become practical; therefore, many things which are now difficult, such as voice recognition, would become comparatively easy and efficient. This would require more complex programs, but programming would also become more efficient.

I will restrict my further comments to sessions on applied problems. In a session on management science applications in education, Michael Carter (University of Toronto) described how to construct a university schedule starting with students' requests for courses, rather than the usual start of a timetable prepared by the academic departments. Arthur J. Swersey (Yale University) showed how linear programming was applied to schedule school buses in New Haven, Connecticut, with very significant reductions in the number of buses required. An interesting sidelight is that the morning and evening problems must be solved simultaneously, but that one is *not* the reverse of the other (because different grades have school days of different lengths). New York City is considering the use of this model; with 2000 school buses in their system, the potential saving is more than \$10 million per year.

In a session on legal problems, David M. Boodman (Arthur D. Little, Inc., Cambridge, MA) gave an exceeding-

ly broad outline of forensic applications of management science. (I was surprised to discover that forensic does not properly refer specifically to the law, but simply to argumentation.) Gerald L. Thompson (Carnegie-Mellon University) and Ferdinand K. Levy (Georgia Institute of Technology) presented a more conventional management-science application: optimization by a law firm of the decision about whether to accept a contingency fee.

In a session on military management science, H.P. Pastijn (Koninklijke Militaire School, Brussels) outlined a fascinating simulation of the arms-control process. Coalitions were taken into account, and stability of the dynamic system was investigated. What I found most interesting was his conclusion that there is no equilibrium; that is, he was unable, even in theory, to find some way of preventing the arms race from escalating.

There were two sessions on sports. Jesper S. Fredriksen (University of Copenhagen) and I discussed paradoxes in subjectively judged competitions (such as Olympic diving, skating, or gymnastics). A theorem by Arrow shows that no rule can eliminate all judging paradoxes, but the rules presented in this session are much improved over those now in use.

I. Vertinsky and P. Vertinsky (University of British Columbia) showed how players and coaches modify their opinions (and hence their strategic judgments) based on the results of previous competitions. Paul Bratley (University of Montreal) tried to predict the outcomes of hockey games for the province of Quebec, which is planning a lottery based on such games.

I came away from the meeting with the feeling that the techniques described and discussed are being very actively and successfully used throughout the world, even though the names "management science" or "operations research" may be used less often than before. People applying these techniques are tending to use other names, such as "systems analysis" or other computer-related terms.

The previous international TIMS meeting was held in 1982 in Lausanne, Switzerland, and the next one will be in 1986, near Brisbane, Australia. TIMS also holds two annual meetings in the US jointly with the Operations Research Society of America.

8/16/84

TECHNOLOGY

UK'S INSTITUTE OF ACOUSTICS IS HEALTHY AND GROWING

by Chester McKinney. Dr. McKinney, formerly at NPL, London, is Senior Research Scientist at Applied Research Laboratories, The University of Texas at Austin.

The importance of professional societies to the effectiveness of a nation's research and development program often is not adequately recognized by employers of scientists and engineers (usually government institutions and industry). The major contributions are through publishing archival journals and holding meetings, but there are others such as sponsoring standards groups, recognizing distinguished work (by medals and awards), funding fellowships, and teaching specialized courses. These functions typically are carried out in an efficient and low-cost manner, using membership funds and revenues from publications sales. In part the low cost is due to the vast amount of volunteer effort.

For the field of acoustics the Acoustical Society of America (ASA) is generally recognized as the premier broad-based society, and its *Journal of the Acoustical Society of America* (JASA) is considered the most prestigious archival journal on the topic. But there are many other fine acoustical groups, and Europe has its share. The Federation of Acoustical Societies of Europe (FASE) counts 26 member societies from 21 countries. The Institute of Acoustics (IOA), with a membership of 1250, is the largest acoustics group in the UK and may well rank second in size in the world (behind the ASA, which has about 6000 members).

The IOA was founded in 1974 by the amalgamation of the Acoustics Group of the Institute of Physics (IOP) and the British Acoustical Society. A major reason for the merger was to host in London the 1974 International Congress on Acoustics. Initially there was a close relation between the IOA and the IOP, but now the IOA is largely independent; in about 1981, headquarters were moved from London to Edinburgh. In 1983 the institute had a net growth of 9.7 percent, which is very high considering the normal 5-percent loss of members due to retirement, death, and other reasons. The IOA is affiliated with FASE, and Professor Brian Clarkson of University College, Swansea, is the current presi-

dent of the federation. There are 165 foreign members (13 percent of total) from 28 countries, which compares with 12 percent for the ASA (outside of North America). The largest foreign group, 45, is in Hong Kong, with the US band of 37 members ranking next. The size of the foreign membership is surprisingly high, since such members seldom are able to attend meetings and no archival journal is included in the annual dues. The highest category of annual dues (fellow) is £40--reasonable, but higher than for the ASA.

The IOS is broad in scope, nurturing essentially all aspects of acoustics. Important parts of the structure are the five special technical groups and the eight regional branches (including one in Hong Kong). The technical groups are: Building Acoustics, Industrial Noise, Musical Acoustics, Speech, and Underwater Acoustics. Some of the groups and branches are very active, while others seem to have difficulty maintaining continuous interest. Technical meetings and conferences are major activities, and there are about 50 each year. These range from 1-day affairs, often sponsored by branches, to 3-day international conferences. In the last 4 months of 1983 there were 18 meetings scheduled. The main IOA meeting is held each spring, and the attendance typically is about 125. The institute also holds an autumn meeting. There is close cooperation between IOA and other UK professional societies, primarily the Institute of Electrical Engineers and the Institute of Mechanical Engineers. Frequently the IOA cosponsors conferences of those institutes and gives good publicity to forthcoming meetings. In the summer of 1983 the IOA conducted Internoise 83 in Edinburgh for the International Institute of Noise Control Engineering. At this conference the attendance was 690 from 38 countries (the largest Internoise outside the US), and 300 papers were presented. A London group organizes and holds a series of London evening meetings each year. The IOA is governed by a council composed of the officers and nine ordinary members. Dr. H.G. Leventhall, Chelsea College and Atkins Research and Development, is the current president; Dr. David Weston, Admiralty Research Establishment-Portland, is immediate past-president; and Professor H. Orhan Berkay, Bath University, is president-elect. The first is well known for his research in noise control, while the last two are well known in the US for their work in underwater acoustics.

The publication program of the IOA has been in a continuous state of change

during its 10-year life but now seems to have settled into a set pattern. A quarterly slick-paper bulletin is in its ninth year of publication. It largely contains IOA news, announcements, reports of meetings, and an occasional survey paper. Special announcements are mailed monthly. The IOA has the excellent policy of having preprints of technical papers available for distribution at the start of each of its major conferences. A new plan is to combine these conference papers into a single volume at the end of each year. The standard length for each paper is eight pages, including figures and references. It is felt that such a document will have archival value and give more prestige to the papers. The institute has given serious thought to the publication of a journal such as JASA but so far has not taken that step. In part this decision is based on the financial burden and in part on uncertainty about the need for another such journal. Their restraint is admirable.

The IOA is very active in educational aspects of acoustics. A major project has been to sponsor the awarding of a diploma in acoustics and noise control upon examination. The institute developed a syllabus for the program (and periodically updates it) and conducts the examination. The examination board, until this past year, was chaired by Professor R.W.B. Stephens. The standards appear to be high--only about half of those taking the exam qualify for the diploma. At present 12 UK colleges teach courses for those seeking the diploma. The IOA also publishes a listing of British universities, technical colleges, and polytechnics which have acoustics programs. Some 58 institutions are included. The IOA for the past few years has sponsored a series of Christmas Lectures for sixth-form students. These usually are given at two or three universities each year.

The IOA has four awards, all named for distinguished British acousticians. The major and oldest is (appropriately) the Rayleigh Medal, given annually, normally in alternate years to a UK citizen and a foreigner. The 1983 medal went to Professor E.J. Skudryzk of Pennsylvania State University, with the 1984 award given to Professor J.E. Ffowcs-Williams, Rank Professor of Physics, Cambridge University. The Tyndall medal is given biennially to a UK citizen, normally under the age of 40. The A.B. Wood medal and monetary prize is given annually, preferably to one who is associated with ocean acoustics, alternately to a UK and a US/Canadian acoustician. The R.B.W. Stephens

annual lecture was initiated in 1984, with the first one being given by Dr. E.A.G. Shaw, National Research Council of Canada and one of Rays' first graduate students. Stephens was the first president of the IOA.

The annual spring and fall meetings of the IOA are a bit unusual in that each meeting does not attempt to cover all areas of acoustics but selects three or four topics for emphasis. The Acoustics 84 meeting was held at the University of Swansea, Wales, from April 9 through 12, with 121 registrants. The technical topics and number of papers (62 total) were: musical acoustics (19); transportation (13); building acoustics (14); biological acoustics (10); and spectrum analysis and speech (6). Fifty-two of the papers were from the UK, and nine from other countries (none from the US). Forty-eight were from universities, six from government activities, and seven from industry. The four invited papers were: (1) "Demonstrations in Aural Perception," by Professor C.A. Taylor, University College, Cardiff; (2) "Understanding the Dynamic Behavior of Complex Vibration," by Skudryzk, the 1983 Rayleigh Medal Lecture (illness had prevented his accepting the award personally in 1983); (3) "Sources of Sound," by Ffowcs-Williams, the 1984 Rayleigh Medal Lecture; and (4) "Recent Advances in Hearing Research: The Convergence Cochlear Mechanics, Physiology, and Psycho-Acoustics," by Shaw, the first R.W.B. Stephens Lecture. The proceedings of the meeting are available from the IOA, 25 Chalmers St., Edinburgh, EH1 1HU, Scotland, for £10.50. Unfortunately, my information is that the texts of the invited lectures will not be included in the proceedings.

The 1984 autumn meeting (November 4 through 6 at Bowness, Scotland) will include sessions on: building insulation and privacy, speech, and ship and diesel engine noise. The 1985 annual meeting will be at York, from April 15 through 17.

It is my clear impression that Underwater Acoustics is the strongest and most active of the IOA groups. This group has a membership of 126, including 19 from other countries (seven from the US). The group sponsors one or more major conferences each year and has published at least 14 sets of proceedings (which are still available from the IOA) from 1975 through 1983. The major 1983 conference was the excellent "Acoustics of the Seabed," held at Bath University, from April 6 through 8. Of the 35 papers, only nine were from the UK and 14 were from the US, with 12 from

other countries. In addition, there were 16 poster papers. The proceedings are in hard-bound format and are available from the University Press, Bath University, for £25. Two conferences are scheduled for 1984: (1) "New Techniques in Sonar Transducers," at Birmingham University, September 5 and 6 (only 12 papers were scheduled, due to the unexpected cancellation of several papers on polyvinylidene fluoride transducers); and (2) "Underwater Acoustic Calibration Measurements," at Bracknell, December 13 and 14. Typically the attendance at underwater acoustic conferences ranges from 75 to 125. Dr. N.G. Pace, Bath University, is current chairman of the group.

It is clear that the IOA is a very active professional group and is playing an important role in UK and foreign acoustics.

8/21/84

NEWS & NOTES

LONG-DISTANCE DIAGNOSTIC SYSTEM

Computer Analysis and Programmers, Ltd., of Reading, UK, recently demonstrated a new mobile communications system that allows a physician in a remote location to consult with medical colleagues thousands of miles away. According to the *London Times*, the system, which fits into a Land-Rover, is currently undergoing extensive trials in Swaziland under the direction of Dr. John Dawson, undersecretary of the British Medical Association.

The vehicle containing the system is completely self-contained, with its own electrical generator and satellite earth station that enables the operator to make telephone calls to any part of the world. The telephone circuit can be used to transmit voice, facsimile, digital data, and telex. In addition, it can send slow-scan black and white television pictures over the telephone line.

The system, which is called Mobility 84, has been designed to help Third World countries improve the level of health care and manage emergency-aid programs more effectively by calling upon the resources of developed nations. The trials in Swaziland recently demonstrated the feasibility of the system when it was used to diagnose a case of the rare Crouzon's disease in a 4-year-old child. Such a system, or a

modification of it, could be used by military physicians and medical corps personnel in remote areas or on surface or underwater vessels.

Thomas C. Rozzell
8/16/84

OXFORD APPOINTS NEW HEAD FOR GEOGRAPHY

Dr. Andrew S. Goudie, a lecturer in geomorphology at Oxford University, has been appointed to the chair, or professorship, in the School of Geography. The appointment was effective October 1. (ESN 38-2:74-75 [1984] describes the geomorphology program at Oxford.)

Goudie's appointment means that geomorphology will be well represented at Oxford over the next several years (he's young and the appointment is essentially for life), but it is unlikely that there will be sweeping changes in the geography program. With very few exceptions, academic departments in the UK are now very stable or actually being cut. This is true of geography departments, where geomorphology is taught in UK universities; however, geomorphology and environmental management are exceptions. These areas have gained a few faculty slots over the past 5 years.

Robert Dolan
7/30/84

ZWO ANNOUNCES AWARD WINNERS

The Netherlands Organization for the Advancement of Pure Research (ZWO) has released details about the winners of grants under its 1984 "Constantijn en Christiaan Huygens-programma" (Table 1, pp 590-591).

These postdoctoral grants are intended to provide support for promising young researchers (see ESN 38-9:517 and 38-8:440-442 [1984]).

Larry E. Shaffer
8/22/84

Table 1
ZWO Award Winners

<u>Name</u>	<u>Address</u>	<u>Field of Study</u>	<u>Research Topic</u>	<u>Place of Study</u>
1. Dr. A. Achterberg	1622 Scenic Avenue Berkeley, CA 94709 (until Sept. 1984)	High-energy astrophysics (plasma astrophysics)	Plasma astrophysics, especially acceleration processes of charged particles in magnetized plasmas in cosmos	Astronomy Institute, State Univ., Utrecht
2. Dr. R.B. Andeweg	Schelpendam 23 2225 MA Katwijk aan Zee	Political sciences	Study of different political systems in general, and minute investigation of decision making within the cabinet council	Dept. of Political Sciences, State Univ., Leiden
3. Drs. R. Bernards	Geuzenkade 69 1056 KN Amsterdam	Tumorigenesis	Investigation of the role of oncogenes in human tumors	State Univ. Leiden/ Netherlands Cancer Institute, Amsterdam
4. Drs. J. Faber	Bedumerstraat 103a 9716 BE Groningen	Political systematics, especially methods and techniques of empirical investigation	Research into the struc- tural effects between the power-, dependency-, interests-, and distance- relations of European coun- tries and their mutual trade, political cooperation in international organizations, alliances, and escalated conflicts	Europa Institute, Univ. of Amsterdam
5. Dr. A.M.B. de Groot	Van Nispenstraat 31 6521 KJ Nijmegen	Psycholinguistics	Semantic memory	Psychology Lab., Catholic Univ., Nijmegen
6. Drs. P.J.M. van Haastert	Spinozalaan 18 2231 SR Rijnsburg	Molecular biology	Research into the operational mechanism of signal transfer in the fungus <u>Diclyostelium</u> <u>discoideum</u>	Dept. of Cell Biology and Genetics, State Univ., Leiden
7. Dr. K.S. Kibs	4a. Hallcroft Beaston, Nottingham 1EL NG9 UK	Neurobiology	Research into membrane pro- cesses in neuroendocrine and neuromuscular systems	Biology Lab., Free Univ., Amsterdam
8. Dr. E.J.J. Knops	Appelhof 2 6584 BL Molenhoek	Sociolinguistics	Investigations in view of enlarging the linguistic component in the formation of theory on language as dimension of social behavior	Nijmegen Center for Dialectology, Catholic Univ., Nijmegen
9. Dr. A.J. Kox	Valeriusstraat 124 hs 1075 GD Amsterdam	Theoretical physics (history)	The evolutionary history of modern physics since H.A. Lorentz and his contem- poraries	Institute of Theoret- ical Physics, Univ. of Amsterdam
10. Drs. T. de Lange	3e Hugo de Groot- straat 12-1 1052 LL Amsterdam	Molecular biology	The molecular basis of trans- formation from normal cells into tumor cells	Netherlands Cancer Institute, Amsterdam
11. Dr. J.D.M. Maassen	Tweede Hunzestraat 19a, 9715 BN Groningen	Theoretical physics	The dynamics of quantum mechanical systems, especially with features of stochastic processes	--

Table 1 (Cont'd)

<u>Name</u>	<u>Address</u>	<u>Field of Study</u>	<u>Research Topic</u>	<u>Place of Study</u>
12. Dr. Ir. N.J.I. Mars	Vuurbloem 9 2317 LN Leiden	Signal analysis	Practical applications of artificial intelligence	State Univ., Leiden
13. Dr. G.J.M. Martens	c/o Dept. of Chemistry University of Oregon Eugene, OR 97403	Biochemistry	The regulation of genes coding for neuropeptides: pro-opiomelanocortin in the pars-intermedia as model system	Zoology Dept., Catholic Univ., Nijmegen
14. Dr. J.W. Niemantsverdriet	Bosboom Toussaint-plein 177 2624 DL Delft	Radiation chemistry	Characterization of catalyzers, especially by means of surface-sensitive techniques	Dept. of Anorganic Chemistry, Technological Univ., Eindhoven
15. Dr. L.L.H. Peeters	Van Weberlaan 20 3055 HX Rotterdam	Gynecology/obstetrics	Physiological changes in mothers' metabolism and circulation in the second half of pregnancy using a model of experiments in animals	Lab. of Experimental Obstetrics, Erasmus Univ., Rotterdam
16. Dr. O. van de Plassche	Institute for Earth Sciences Free University P.O. Box 7161 1007 MC Amsterdam	Physical geography	Research into the causes and effects of sea-level movements in connection with the build-up and genesis of Holocene coastal plains	Free University and others (US)
17. Dr. R.H.A. Plasterk	Herenstraat 87d 2313 AG Leiden	Molecular genetics	Research into the regulation of gene expression by DNA rearrangement	Biochemistry Lab., State Univ., Leiden
18. Dr. D.T. Runia	Esdoornhof 78 8266 GK Kampen	Philosophy	The philosophical aspects of patristic thinking, especially in relation with the influence of Philo	Central Interfaculty, Free Univ., Amsterdam
19. Dr. R. van der Sandt	Joh. Vijghstraat 65 6524 BP Nijmegen	Theoretical semantics and pragmatics	Analysis of the nature and working of speech acts in context in order to develop a formal context theory	Central Interfaculty, Catholic Univ., Nijmegen
20. Ir. A. Wink	Tichelstraat 47 hs 1015 KS Amsterdam	Agrarian sociology of nonwestern areas	Study of land rights in South Asia during the Indo-Muslim period	Institute "Kern," Leiden

SCIENCE NEWSBRIEFS FOR AUGUST

The following issues of *Science Newsbrief* were published by the ONR, London, Scientific Liaison Division during August. *Science Newsbrief* provides concise accounts of scientific developments or science policy in Europe and the Middle East. Please request copies, by number, from ONR, London.

Science Newsbrief NumberTitle

2-9-84

Change in Fluid Dynamics Group at Cambridge, by Robert Dolan.

2-10-84

Bieberbach Conjecture Proven, by Charles Holland.

2-11-84

UK's Alvey Program Invests £65 Million in VLSI Projects, by J.F. Blackburn.

AUGUST MAS BULLETINS

The following *Military Applications Summary (MAS) Bulletins* were published by the ONR, London, Military Applications Division during August. The *MAS Bulletin* is an account of naval developments in European research, development, test, and evaluation. Its distribution is limited to offices in the US Department of Defense. DoD organizations should request copies of the *Bulletins*, by number, from ONR, London.

<u>MASB Number</u>	<u>Title</u>
49-84	Update on Remote Sensing Outside UK
50-84	Update on Remote Sensing at UK's NRSC
51-84	The UK Ministry of Defence Announces the Results of Reorganization and New Top Appointments
52-84	MIZEX Operations Aboard POLAR QUEEN, 29 May 1984 - 29 July 1984
53-84	Operational RN Oceanographic Models
54-84	Institute of Oceanographic Sciences, Wormley, UK, Autumn Seminar Program
55-84	Canadian Remote Sensing
56-84	Signal and Image Processing at a UK Company
58-84	UK Aerospace Update

ONRL REPORTS

To request reports, check the boxes on the self-addressed mailer and return it to ONR, London.

- C-2-84: *ONR, London, Workshop on Computer Architecture*, by J.F. Blackburn. The US Office of Naval Research, London, hosted a workshop on computer architecture on 16 and 17 May 1984. The meeting brought together 12 of the leading research professionals in European universities and several interested persons from the US government to discuss the present state of research in this important field and to assess future directions. Most of the discussion was on hardware design; one presentation concentrated on the programming of parallel processing systems.
- C-3-84: *International Symposium on Mine Warfare Vessels and Systems*, by Chester McKinney. The International Symposium on Mine Warfare Vessels and Systems was held in London from 12 through 15 June 1984. This report discusses presentations on platforms and propulsion equipment for mine countermeasures systems, and minehunting systems and components.
- C-4-84: *Second International Logic Programming Conference*, by J.F. Blackburn. The Second International Logic Programming Conference was held at Uppsala University, Sweden, from 2 through 6 July 1984. Presentations at the conference suggest that although logic programming is in the very early stages of exploitation, it is already becoming a useful tool.
- R-10-84: *Computer Science Research in Europe*, by J.F. Blackburn. Computer architecture, programming, and robotics represent the major new directions in European computer-science research. In computer architecture the emphasis is on large-scale computing. Functional and logic programming are receiving much attention. Sensing and control are featured in the robotics research.

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